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The Urgent Need for Increased Production.

M. CULLITY, Superintendent of Dairying.

DAIRY PRODUCE.

Considerable attention has been directed in recent months to the need for increasing the output of all forms of dairy produce. This increased production is needed for export to Great Britain to help fill the gap caused by the loss of European sources of supply and by decreased exports from the Dominions, and which has meant a great reduction in the amount of butter available to her population. Rising consumption within Australia, combined with decreasing production, makes the problem urgent.

The Australian dairy farmer has been asked to play his part by maintaining or, if possible, increasing the output from his farm.

He has experienced many difficulties which have been disheartening and while efforts are being made to find solutions to the problems of labour and equipment, he is asked to continue his operations to the best of his ability. Each is asked to set a target of production for his own farm so that a definite objective will be in view and arrangements made to attain it.

It is suggested that in addition to the normal activities which might be included under the general heading of efficient dairy husbandry—which would include the use of good cows mated to proved bulls, the rearing in a proper manner of the best heifers, adequate feeding, etc.—particular attention should be directed towards the following points which are considered to offer the greatest opportunity of increasing production:—

1. *Size of Herds.*

Herds should be maintained at the maximum size permitted by the condition of the property and the facilities available for milking. The number of cows must bear relation to the amount of pasture available as over-stocking must be avoided. It is far better to have a few cows under capacity on a farm than to have one or two too many. In the case where a number of young stock are kept, the owner

should consider the advisability of reducing the number to a bare sufficiency for replenishing his herd so as to enable him to increase the actual number of cows that can be carried.

2. *Top-dressing.*

While reduced quantities of superphosphate are available, as a general rule, it is advised that it should be spread evenly over all paddocks each year. In the newer districts particularly, it is advisable to do this, as otherwise too great a deterioration of the clover pastures, in the areas lightly dressed or left not top-dressed, would occur.

Fortunately for the year 1943-44 an increased ration of super will be allowed for dairy pastures which will be approximately 75 per cent. of the normal usage. It is expected that farmers will take full advantage of this special allowance which is intended to assist them in increasing production.

3. *Early Calving.*

Mating cows to calve during the period from the end of March to the end July will allow the cows to produce more than if they calve at any other period of the year. The average production per cow according to the month of calving for 36,986 lactations is shown in the accompanying graph. (Page 172, Jnl. Agric., Sept., 1941.) There is no doubt that this aspect of the management of a herd holds one of the greatest possible opportunities for increasing production.

4. *Feed.*

When arrangements have been made to bring the cows in early, it is essential that a sufficient supply of feed be available for use prior to calving and to supplement the pasture until the spring growth commences. This can be obtained by conserving an adequate quantity of hay and silage and may be supplemented by the growing of an early oat crop. Labour difficulties may prevent the individual farmer from harvesting as much hay or silage as he normally would and these may be best overcome if farmers arranged themselves into small groups which would assist one another in cutting and carting the hay on their various farms.

The effect of having plentiful feed is particularly well demonstrated during the present season as the early rains have caused the growth of pasture which has enabled the output of dairy produce in April and May to be more than thirty per cent. higher than in April and May of 1942. In normal seasons this production could be achieved by having an adequate quantity of conserved fodder which would be utilised for feeding cows nearing calving and for those which had already commenced their lactations.

The feeding of dairy cows approaching calving is most important as during that period it is essential for the cow to be provided with adequate supplies of good feed in order to be in a position to meet the demands of her unborn calf.

If this feed is not provided in sufficient quantities the result will be that the cow will be in a poor condition when she calves and will then necessarily devote her energies during the subsequent three months to building herself up, whereas had she been in good condition at calving time this energy would have been devoted to producing milk, thus increasing her total production.

A plentiful supply of hay will also allow pastures to be shut up at the commencement of the season, so that the plants can make good growth and root development before being grazed.

PIG MEATS.

A similar position to that described for Dairy Produce exists for pig-meat. The increased population in Australia naturally has created a higher demand, and coupled to this is the fact that our American Allies consume a greater amount of pig-meat than we do. Certain commitments to Great Britain also have been undertaken and the effort to fulfil these is a matter requiring the special attention of pig raisers. To do this Western Australia had to produce more pigs than ever before.

The recently announced pig purchase plan guarantees that pigs will be purchased at satisfactory prices for at least the next two years.

Success in increasing production could be achieved by the adoption of the following points:—

1. *Maximum Herd Size.*—The number of sows which are kept should be increased to the limit of the manpower available.

2. Breeding stock of good type and from a prolific strain should be selected.

3. Sows should be mated to farrow frequently: two litters per year are possible.

4. In the grain-growing areas, a mixture of wheat and meat-meal in the proportion of 9 : 1 should be fed, using two per cent. ground limestone or bone-meal. After the pigs reach about 100 lb. deadweight, 10 per cent, cereal chaff should be added to the mixture in order to slow down the rate for deposition of fat while the animal is still growing.

5. In the dairying areas the skim milk available should be supplemented with grain in order to feed more pigs. In addition to one gallon of milk, 1 lb. of grain should be used for each month of age over two months.

6. Wheat is available from the Wheat Board, through its brokers, the Trustees of the Western Australian Wheat Pool, at a price of 3s. 6½d. per bushel in bags at Bunbury or Geraldton, or 3s. 3½d. in bulk at Picton and Fremantle. These prices are for truck lots and where individual farmers are unable to finance this quantity, a group of farmers could arrange to share one order.

Occasionally inferior wheat, but still suitable for feeding, is available at lower prices.

7. Light weight or unfinished pigs should not be marketed.

The Argentine Ant.

(Iridomyrmex humilis. Mayr.). E.M.N.

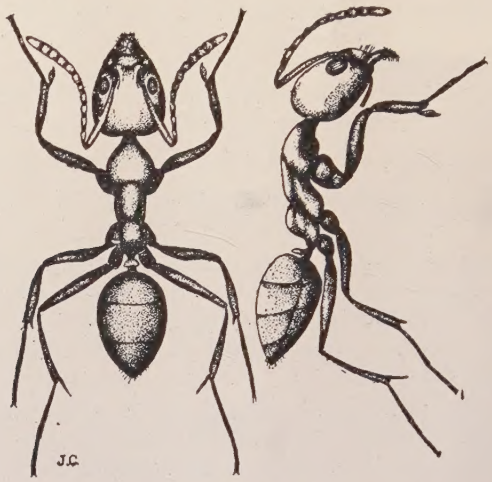
A NEW PEST IN WESTERN AUSTRALIA.

C. F. H. JENKINS, Government Entomologist.

The native home of this ant, as its name implies, is believed to be the Argentine Republic. It is recorded, however, from other South American countries, and has been introduced into the United States of America, where it is reported to be still spreading. It is now established in many countries of the world and on the island of Madeira is said to have been so successful as to have supplanted completely all the native ants on the island. It was known in South Africa as long ago as 1908, and it still remains a serious pest in that country.

The first record of the ant in Australia came from Victoria in September, 1939. It was not long, however, before the pest was located in Western Australia, the original specimens being sent to the Department for Agriculture for identification by residents of Albany in April, 1941.

Regulations were immediately gazetted quarantining the affected area, but unfortunately later inspections made in metropolitan districts, showed that the ant had gained a firmer hold than was first suspected. It has now been necessary to prevent the sending, from within a five-mile radius of the Perth Town Hall to other parts of the State, plants in pots or packed in soil except with a permit from the Department of Agriculture.



Argentine Ant Workers.
(After Clark.)

GENERAL DESCRIPTION.

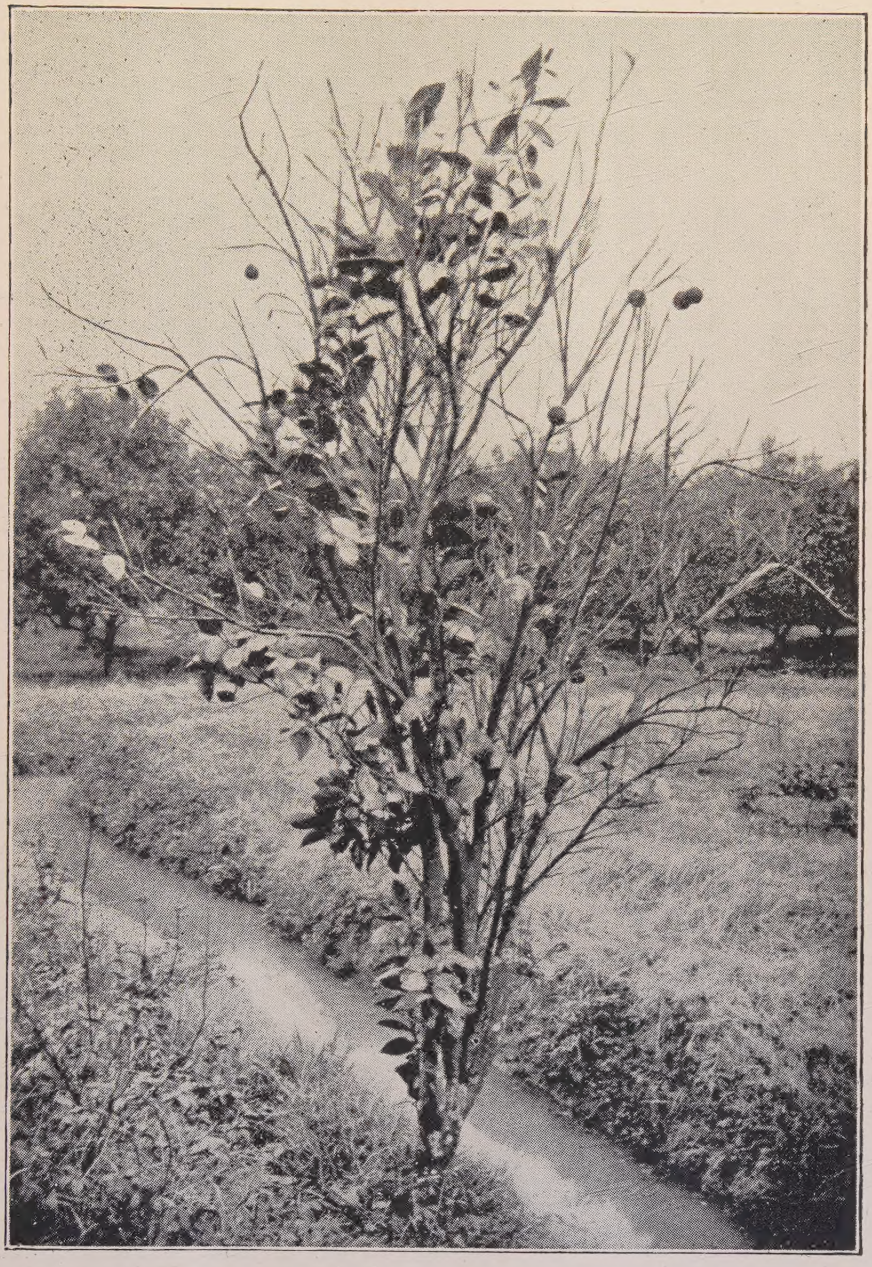
Being social creatures, Argentine Ant colonies contain queens, males, and workers. It is the workers which are most commonly seen, and whose presence cause the actual trouble. In size they resemble very closely a number of other common house ants measuring about $\frac{1}{8}$ of an inch in length. They are a uniform honey brown in colour, and do not give off the formic acid smell so characteristic of most ants when crushed. This is not an infallible means of identification, however, as other local ants are also characterised by this lack of odour.

The winged male ants are seldom seen, but are somewhat larger than the workers. The virgin queens are winged and are also larger than the workers. When saddled with the responsibility of maintaining the population numbers of a colony they grow still more, due to the increase in the size of the egg-distended abdomen, and shed their wings.

LIFE HISTORY AND HABITS.

The size of ant colonies may vary considerably, containing from dozens to thousands of individuals, and the number of queens present may vary from one to a hundred.

The full details of the life history have not been worked out locally, but in America the ant has been exhaustively studied. It has been found that after the appearance of winged males and females in the nest a nuptial flight may or may



An orange tree showing effects of three years' exposure to Argentine Ant infestation.
(From U.S. Dept. Agric.)

not follow. In either case the females, after becoming fertile, lose their wings and commence egg laying. They may lay 30 or more eggs a day, and live for several years. Most of the eggs develop into worker ants, but at certain seasons males and queens also appear. Like most ants the individuals of this species are great

foragers. Strong trails of the insects will travel considerable distances in search of food, invade houses, or swarm over trees and other objects where suitable attractions are to be found. So strong is their colonising ability that other ant species often find it difficult or impossible to survive where the Argentine Ant is well established.

MEANS OF DISPERSAL.

The fact that nuptial flights are not the regular habit of this ant, and that in some countries the females have not been seen to fly at all means that the natural dispersal of the pest is very slow. It is mainly by artificial means that the insects have been spread about the world, and here again is an important point to note. In order for the species to establish itself a whole colony containing at least one fertile queen must be transported. It is not enough to carry large numbers of workers to a fresh district. These may survive for a long time, but they would not be able to reproduce.

It will now be clear why strict quarantine regulations are passed preventing the removal of plants in pots and soil from infested areas, for by such means a whole colony may easily be carried. It is a common habit of the ant to establish itself in seed boxes or pot plants or even debris and leaves associated with plants. It is by no means only in plants, however, that the insects can be spread, for colonies may make their way into old packing cases and similar refuges, but infested nursery stocks are generally considered to be the most dangerous sources of dispersal.

TYPE OF DAMAGE CAUSED.

Besides being a domestic menace, the ant is a serious orchard pest and it is as such that it is mainly feared.

Injury is not actually caused by the ant itself, but the creatures are greatly attracted by the honey-dew given off by scale insects, aphides, and mealy bugs, and so heavily infest trees carrying these pests. The swarms of ants running hither and thither over the twigs and branches prevent ladybirds, parasitic wasps, and other useful insects from exerting their normal control, and furthermore the actual attention from the ants causes more honey-dew than usual to be excreted. Consequently fruit and foliage is soon covered with the dirty sooty mould fungus associated with insect honey-dew, and the scale or aphis population rapidly rises with consequent detrimental effects upon the trees.

Fortunately, as far as is known, no orchard districts have been yet infested in Western Australia, but in California and South Africa the control of such pests as mealy bugs and red scale is largely dependent upon whether the Argentine Ant can first be subjugated.

As a Household Pest.

The Argentine Ant is practically omnivorous in its taste, attacking sweets such as sugar or honey and cooked meat or bones with almost equal readiness. Its persistence is unequalled by any other species, and at times houses have even been vacated on account of the persecution of this insect.

CONTROL.

The first essential in controlling ants as household pests is to see that no crumbs or particles of food are left about to attract the insects. Despite all efforts, however, more direct action is often necessary and circumstances determine just what method may be used most effectively.

Small colony of Argentine Ants.
(From U.S. Dept. Agric.)

Fumigation.

When it is possible to find the ants' nests by tracing along the trail of workers, the entire colony may be destroyed by pouring into the hole a couple of tablespoonfuls of carbon bisulphide. Where several holes are present all should

be treated and the openings blocked with moist earth to prevent the escape of the heavy gas generated. Carbon bisulphide is explosive and inflammable, and so should be used with care.

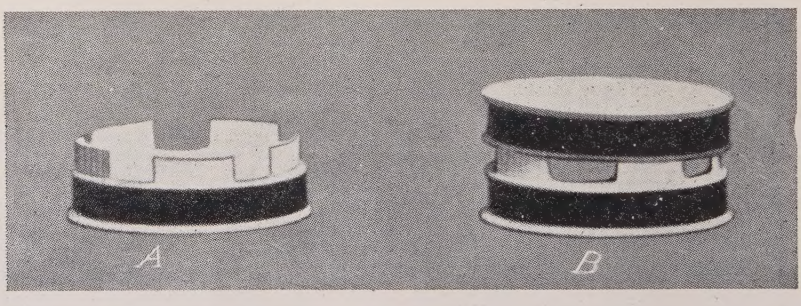
A liberal sprinkling of calcium cyanide dust into the hole if the entrance is subsequently blocked will also be found effective.

Poison Dusts.

Many types of powder are used against ants with varying degrees of success. One of the most useful is powdered sodium fluoride, but powdered arsenic, sheep dip (containing arsenic), Paris green and sodium fluosilicate are useful. The powders should be sprinkled about in places frequented by the ants and liberally sprinkled into and around the entrance to their nests. The efficiency of powders depends upon their being finely ground and dry, for the tiny particles cling to the legs and body of the workers and are eaten in subsequent cleaning and grooming operations, as well as being fed to the queen and other occupants of the nest. Ant eradication by this means is a long process, but it is only by patience and persistent treatment that the pest usually is overcome.

Argentine Ant Bait.

Unfortunately ants are very sensitive indeed to poisons and many baits are taken for a short time and then entirely ignored. On this account it is quite impossible to prescribe a universal ant bait. A formula which has been satisfactorily used, however, against the Argentine Ant in many countries as well as locally is prepared as follows:—Sugar, 1 lb.; tartaric acid, crystallised, 10.3 grains; benzoate of soda, 14.6 grains; sodium arsenite (chemically pure), 26 grains; water, 5-6ths pint; honey, 2 1-3 oz.



Bait Tin.
A, Showing method of cutting sides; B, Lid in place and tin ready for use.
(From U.S. Dept. Agric.)

The water should be warmed in a clean vessel over a low fire. When it is tepid, the tartaric acid, benzoate of soda, and the sugar (slowly) should be added. The mixture must be stirred constantly to prevent burning. The depth of the liquid in the vessel should be measured with a stick. Then bring the mixture slowly to the boil and allow to simmer for 30 to 40 minutes. Remove from the stove and add water to the original depth on the measuring stick to make up for evaporation. The honey should then be stirred in before the mixture cools and the sodium arsenite, which has been dissolved in 1.8 fluid oz. of hot water and partially cooled, poured into the syrup.

The foregoing preparation is on the local market as a proprietary line, and is sold under the name of Argentine Ant poison.

Other Formulae.

(1) 1½ lb. sugar or honey.
2 pints water.
31 grains arsenite of soda (equal to a moderately heaped penny).
Dissolve the sugar in warm water, then add arsenite of soda, stirring well.

(2) For meat and fat eating ants the following bait may be tried:—
Fat, 1½ breakfast cups.
Arsenite of soda, 5 grains (moderately heaped threepenny bit).

Warm the fat and stir in the poison. Bacon rind with a little poison rubbed into the fat may also be tried. The danger to animals and children of such baits should be remembered.

Syrup baits are best used in closed tins perforated in such a way that the ants can enter but so that the contents are protected from dogs, children, etc. The bait tins should be filled with syrup and a small piece of sponge, flannel, or other absorbent material may be placed inside to sop up some of the liquid and give the ants some suitable support on which to feed. As many bait tins as possible should be put near ant nests and tracks so that the insects will feed outside and not be attracted to enter the house.

The total destruction of a nest will take time for until the queen and all the developing ants have been fed with the poison some of the insects at least will still be roaming at large.

Readers who have reason to suspect that they are being troubled by the Argentine Ant are asked to forward specimens to the Department of Agriculture for identification.

ACKNOWLEDGMENTS.

The writer is indebted to Mr. J. Clarke, Entomologist in the National Museum, Melbourne, for the identification of various ants collected during the above investigation.

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Red-Legged Earth Mite.

(*Halotydaeus destructor*)

(Tucker).

A SEASONAL REMINDER.

C. F. H. JENKINS, Government Entomologist.

A common pest at this season of the year is the Red-legged Earth Mite, and unless effectively controlled this creature can decimate the most promising batches of vegetable seedlings.

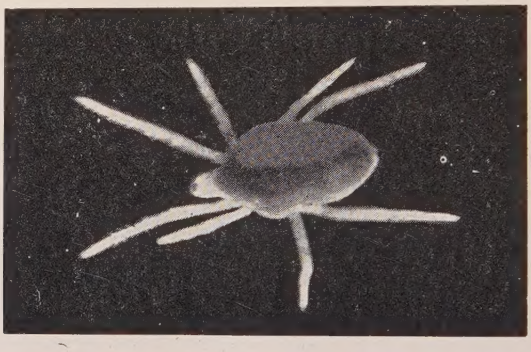
HABITS.

The red-legged earth mite is rather a delicate creature and is very susceptible to dryness, consequently it is only a pest during the winter months. It prefers moist sheltered situations, and thrives especially where such weeds as cape weed are allowed to grow abundantly.

It is mainly on seedlings that the mite's attack is most serious. As soon as the tiny leaves appear the mites swarm upon them and cause them to bleach and wither. The mouth parts of the creature are adapted for rasping or lacerating the plant tissue, and the exuding sap is sucked up. Typical mite injury is indicated by the bleaching and whitening of the attacked foliage, but the absence of actual holes in the leaves distinguishes the injury from the bleaching caused by the lucerne flea, which also attacks pasture plants and many cultivated crops.

The mites are gregarious in habits, often feeding in clusters on a leaf or sheltering together in slight depressions in the ground. When disturbed they scatter in all directions, and if on a plant will usually fall directly to the ground.

The name earth mite is quite apt for the creature, as it seldom goes far from that element, and returns there as quickly as possible at the first sign of trouble.



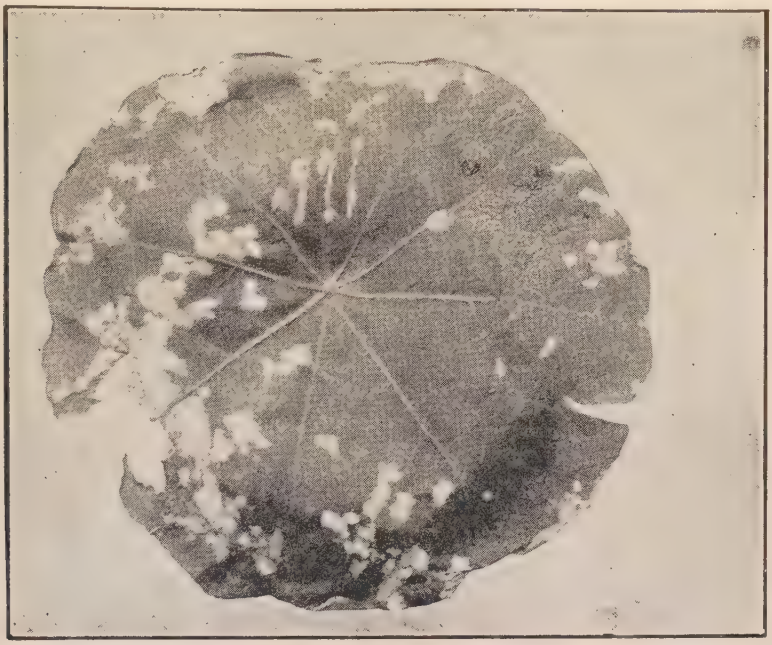
Adult mite, dorsal view, magnified by 20.

CONTROL.

Cultural Methods.—In order to minimise the depredations of this pest all weed growth and especially cape weed plants should be carefully destroyed. If the mites have already appeared for the season, soil to be planted should be turned over and left weed-free if possible for about a fortnight in order to starve out any mites on the plot. Once seeds or young plants have been put in they should be forced along as much as possible by suitable fertilising and watering, for when firmly established many plants can throw off mite injury. If seedlings can be raised early in the autumn before the mite appears, so much the better.

Dusts.—A number of dusts have been tried against this pest with good success, but any artificial treatments must be constantly repeated and will only be successful if combined with suitable cultural methods.

In applying dusts fine weather should be chosen for the treatement whenever possible.



Leaf of plant showing typical injury caused by mite.

Formulae:

1. Tobacco dust, 1 part; slaked lime, 1 part. This dust may be sprinkled on foliage without fear of injury, and is definitely more effective in fine than in cold, damp weather.

2. Fifteen per cent. carbolic powder, 1 lb.; slaked lime or superphosphate, 4 lb. This dust will burn if sprinkled over moist foliage and so should be scattered on the soil around the plants. If some powdered manure is used as a carrier a dual purpose will be served. The carbolic acts as a slight repellent as well as a miticide.

Repellents.

Flaked naphthalene liberally sprinkled over the plants will both kill and repel the mites.

Creosote is a very effective repellent and may be used with advantage to protect small plots. If the plot has a wooden border, or is fenced off with galvanised iron a few inches high, the boundary can be painted with creosote and will effectively prevent the entry of any mites from the outside. Thoroughly saturated wood might remain effective for a month or even longer, and the iron for a week or more. Even if poured on to the soil and left undisturbed, creosote will form an effective barrier for some time.

Sprays.

1. Black Leaf 40, 1½ teaspoonfuls; soap, 1 ounce; water, 1 gallon.
2. Kerosene emulsion used at a dilution of 1 to 8. To mix dissolve ½ lb. of soap in 1 gallon of boiling water. Allow to cool slightly

and churn in, pouring slowly, 2 gallons of kerosene. This will make a stock solution for keeping which may be diluted as required by thoroughly churning in further warm water.

3. Disinfectant phenyle, 1 part; water, 80 parts. This should be applied with a strong spray, preferably on to the mites on the soil. The foliage should be avoided as much as possible, although at the dilution mentioned burning is not usually serious.

A number of proprietary sprays and dusts are recommended for use against the mite, and several may be used with advantage. It must be remembered, however, that whatever sprays or dusts are used, satisfactory control will only be obtained when repeated treatments are given and when these treatments are combined with clean cultural methods.

Cockroaches, and an Effective Method of Trapping.

C. F. H. JENKINS, Government Entomologist.

Several species of cockroaches are now general household pests. In this country some of the native varieties have become semi-domesticated and, in addition, several introduced forms are to be met with.

The large reddish-brown winged cockroach (*Periplaneta americana* L.) is probably the most universal. It measures about 1½ inches in length and is the largest domestic roach found in this State. Another common species is the much smaller German roach (*Blatella germanica* (L.)), brownish in colour and characterised by the two black stripes on the thorax.

The American Cockroach.
(U.S. Dept. Agric.)

Cockroaches are practically omnivorous but are particularly fond of foodstuffs favoured by man. On this account the insect frequently assumes plague proportions in kitchens and galleys.

LIFE HISTORY.

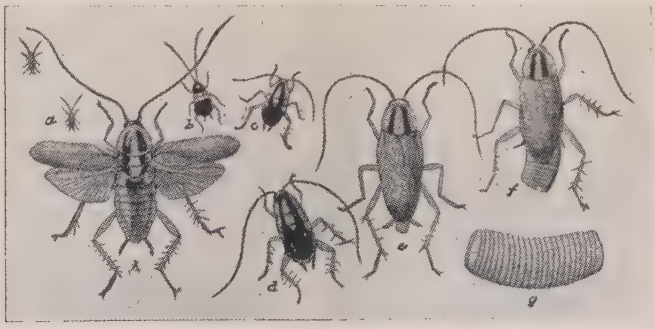
The eggs of the cockroach are developed in a chitinous capsule or packet, which is carried for a time protruding from the abdomen of the female. These capsules may be found attached to rafters, books, boxes, or other rough surfaces. In the case of the American cockroach, attempts may be made to cover the egg capsules with bits of chewed paper, etc.

The young, on hatching, have the general form of the adult. They moult several times and reach maturity after several months.

The exact duration of the different stages varies considerably. For the egg stage 70 days at 77deg. F. has been quoted as the developmental period, but under Australian summer conditions this time is probably reduced. Several months or perhaps a year may elapse before the adult stage is reached. The female may lay a number of capsules, each containing approximately 16 eggs. The longevity of the adults is considerable, for an individual under observation in this laboratory survived for over two years.

RELATIONSHIP TO DISEASE.

On account of its association with offal and scraps of all kinds the cockroach is a potential mechanical carrier of disease. Roaches have been known to eat infected excrement and disgorge infective material some time later.



The German Cockroach: a-d, Immature specimens; e, Male; f, Female with egg case; g, Egg case enlarged.
(U.S. Dept. of Agric.)

CONTROL.

Meticulous care with regard to the disposal of foodstuffs and scraps is the first essential in any attempt to control this pest.

Sprays.—The use of kerosene-pyrethrum fly sprays, where direct contact can be obtained, is effective, but on account of the insects' nocturnal habits this contact is usually difficult to achieve.

Dusts.—The use of various dusts to be sprinkled into cracks and crevices or in situations which the roaches are known to visit, is widely recommended.

Sodium fluoride is the most effective of these dusts and under dry conditions can be thoroughly recommended. Borax is a dust which, although less effective than sodium fluoride, is not poisonous to humans. For ordinary household infes-

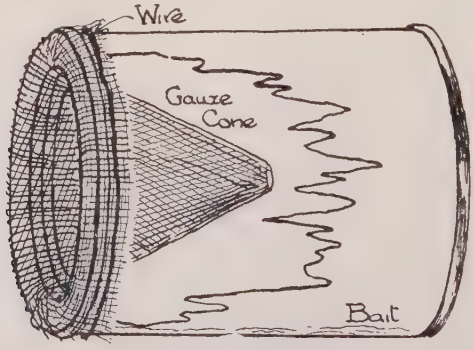
tations, borax and borax and sodium fluoride mixed may be used. The higher the proportion of the latter the more rapid will be the results obtained. Sodium fluosilicate may be used if sodium fluoride is not available.

In order to be effective, dusts must be finely ground and dry. They depend for their efficiency not upon the fact that they are palatable and so eaten by the roaches, but upon the fact that the tiny particles cling to the legs and antennae of the insects and are subsequently swallowed when these members are licked and cleaned in subsequent grooming operations. Dusts containing pyrethrum and derris are also effective, but pyrethrum rapidly deteriorates on exposure to the air and so only fresh dust is effective.

Traps and Baits.—A recently devised trap has proved most effective in catching large quantities of cockroaches for laboratory purposes and should be useful in any infested premises. The trap may be made from a suitable sized tin with a flanged edge, such as is found in press-top treacle tins. The flange enables a small quantity of liquid bait to be retained when the tin is laid in position on its side. A tapering cone of fly-wire is fitted into the tin and a flattened hole about 5/8 inch broad and 3/8 of an inch high is made in the apex of the cone to give the insects free entry. The cone may be held in position by allowing the wire at the base to fold over on to the outside of the tin, where it may be secured by a piece of thin wire.

A neater article may be achieved by cutting almost the entire centre out of the press-top lid and soldering the cone into position. This will enable the trap to be easily dismantled for emptying and cleaning.

Glass screw-top jars shaped so that they retain a little liquid when placed on their side could be used instead of tins, and in the absence of fly-wire, cardboard or metal cones could no doubt be shaped and glued or soldered into place.



Cockroach Trap.

One of the most attractive materials for cockroaches is stale beer, and traps should be baited with a few drops of this liquid before being placed on their side behind stoves, in cupboards, or in other likely situations. The best results so far obtained have followed the use of stale beer, but if this is not available moist apple peelings or water sweetened with treacle or a few food scraps may be tried.

Traps should not be cleaned or washed with strong disinfectant materials, as the smell may act as a repellent to the cockroaches, and reduce the efficiency of the trap.

A bait said to be also very effective is phosphorous rat poison. This should be smeared over the surface of a piece of cardboard, the latter being rolled into a cylinder with the bait on the inside.

It may be noted in conclusion that a widely published bait, employing plaster of Paris, flour, and water has been shown to be founded upon inaccurate observations and should not be relied upon.

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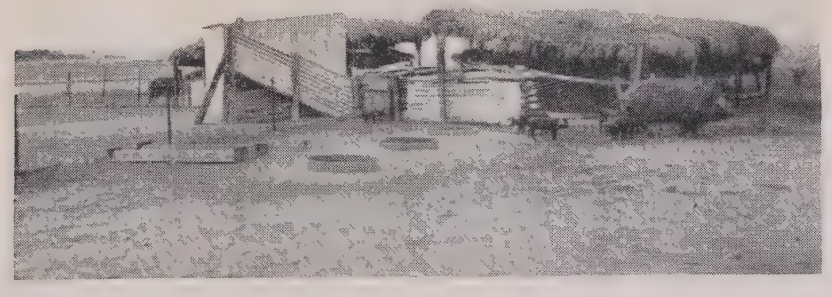
The Cost of Raising Pigs in the Wheat Belt.

F. V. Knapp, Agricultural Adviser.

So that information could be obtained as to the costs of feeds and the financial returns of pig raising in the wheatbelt, the writer made arrangements with certain pig raisers to keep full records of their costs and returns for at least one year. It is proposed in this article to deal with the results obtained by Mr. K. Giles, of Doodlakine, for the years 1941 and 1942.

Mr. Giles commenced pig raising during early January, 1941, when he bought three sows in pig, a gilt, and one boar. The three sows were on their second litter. The housing system adopted was of the semi-intensive type; the piggery being divided up into yards (varying in area from four square chain to 10 square chain) and each yard had a breeding pen, half of which was roofed, into which the pigs could be confined when necessary. During the winter months certain of the yards were sown with a cereal for grazing purposes. Just prior to pigging the sow was confined to a breeding pen, and after pigging she and her litter were confined for a further ten days. They were then given the run of the appropriate yard. The young pigs were castrated when about five weeks old and weaned at eight weeks—the sow being placed in with the boar, and the weaners in one of the large yards.



North-west view of yards. Note race at side of feed shed and double roof for coolness. Note sheets of galvanised iron at back and sides of farrowing pen to prevent draughts and consequent pneumonia.

The feeding procedure was as follows: Dry sows and the boar were given grazing supplemented with crushed grain. When no grazing was available they were fed on chaff and crushed grain. From the time of being confined to the breeding pen until weaning the sow and litter were given a ration of approximately 88 per cent. crushed wheat, 10 per cent. meatmeal, and two per cent. lime, supplemented with grazing. After weaning the weaners were given a similar ration, except that as they grew older the percentage of meatmeal was gradually reduced until at the time of marketing they were receiving crushed grain alone. The pigs were fed twice a day, all food being fed dry, but they had access to clean drinking water. During 1941, crushed oats were mixed with the wheat throughout the year in order to use them up.

Looking south from top of feed shed. Note gates leading out into three of the yards. In the foreground may be seen the tap for the central watering trough.

All the pigs were sold at "so much per lb. dressed weight" and 70 per cent. of the liveweight was taken as the dressed weight. Marketing restrictions necessitated that during 1941 all pigs should be marketed at the heavy porker stage, whilst in 1942 they were sold as baconers. In 1941 thirty-six pigs were sold at an average liveweight of 150 lb., the average time from birth to marketing being 165 days. In 1942 fifty pigs were sold at an average liveweight of 167 lb., the average time from birth to marketing being 182 days; in addition to these there were 15 pigs on hand at 31st December, 1942, which could not be marketed before that date for various reasons, the value of these have been taken into account in working out the returns for 1942. To ensure that pigs did not exceed the maximum weights, they were weighed at regular intervals prior to marketing.

During 1941, each sow had two litters, the average number per litter being six, all of which were marketed. However, in 1942, the average number of pigs marketed per litter increased to 9.3.

The returns, food fed, etc., for the years 1941 and 1942 are set out in Tables 1 and 2 respectively.

TABLE 1 (1941).

Food.*	Per Pig Marketed.	Per lb. Liveweight.	Per lb. Dressed Weight.	Per Day.
Wheat	9 bus. 25 lb.	3·77 lb.	5·38 lb.	3·46 lb.
Oats	2 bus. 8 lb.	·59 lb.	·84 lb.	·54 lb.
Total Cereals	653 lb.	4·36 lb.	6·22 lb.	4·00 lb.
Meatmeal	28 lb.	3·00 ozs.	4·27 ozs.	2·70 ozs.
Total Food	681 lb.	4·56 lb.	6·50 lb.	4·13 lb.
Net Returns	£2 13s. 6d.	4·28d.	6·11d.	...
Total Costs	£1 15s. 0d.	2·80d.	4·00d.	...
Profit	18s. 6d.	1·48d.	2·11d.	...

* Includes food fed to sows and boar. Liveweight gain per day of marketed pigs—0·92 lb.

Assuming that the amount of oats eaten had been wheat and excluding labour costs and interest on capital expenditure, the price obtained per bushel of wheat is as follows:—

	£ s. d.
Total net returns	96 4 11
Less value of meatmeal	7 10 0
Value of wheat	88 14 11
Quantity of wheat fed	382 bushels

$$\text{Value wheat per bushel} = \frac{88\ 14\ 11}{382}$$

= 4s. 6d.

TABLE 2 (1942).

Food.*	Per Pig Marketable.	Per lb. Liveweight.	Per lb. Dressed Weight.	Per Day.
Wheat	10 bus. 0 lb.	3·90 lb.	5·40 lb.	3·43 lb.
Meatmeal	23 lb.	2·37 ozs.	3·38 ozs.	2·10 ozs.
Total Food	623 lb.	4·00 lb.	5·70 lb.	3·56 lb.
Nett Returns	£3 0s. 0d.	4·82d.	6·85d.	...
Total Costs	£1 13s. 8d.	2·60d.	3·70d.	...
Profit	£1 6s. 4d.	2·00d.	2·90d.	...

* Includes food fed to sows and boar. Liveweight gain per day of marketable pigs—0·89 lb.

Price obtained per bushel of wheat fed:—

$$\frac{\text{Returns less cost of meatmeal}}{\text{Quantity of wheat fed (bus.)}} = \frac{\text{£183 0s. 8d.}}{650}$$

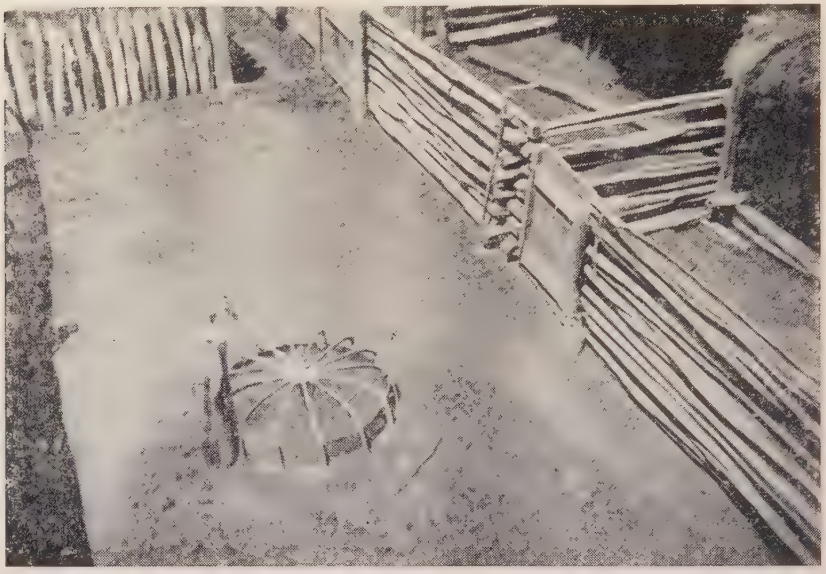
= 5s. 6d.

DISCUSSION.

The average number of pigs marketed per litter (6) in 1941 may appear low, but it must be remembered that the sows were young. From the writer's observations it would appear as though six is about the average number marketed per

litter in the wheatbelt. In 1942 the number marketed per litter had risen to the highly satisfactory figure of 9.3; this increase is partially due to the sows being older and also indicates the good conditions under which the pigs are reared.

Owing to the marketing restrictions, the annual profit per breeding sow in 1941 was only £11; however in 1942, with increased numbers per litter, a raising of the maximum weight for marketing and a slightly better price per pound, the annual profit per sow was £21, an increase of £10 on the figure for 1941. *Of this increase approximately £7 is due to the additional number of pigs per litter marketed*, consequently it is essential for good returns, to obtain highly productive sows and to rear every pig in a litter to marketing stage.



Drinking water trough made so as to prevent pigs getting in it, and placed in passage between farrowing pens. Also shown is the tap for one of the farrowing pens.

A point of particular interest in the tables is the low proportion of high protein concentrate (meatmeal) in the ration fed. As the rate of growth of the pigs was quite fast and the pigs marketed in good condition it is concluded that sufficient protein was available. A large percentage of the protein required must have been supplied in the grazing of cereal crops provided. This is of particular importance to pig raisers in the wheatbelt at the present time, as it points to an alternative supply of protein to meatmeal which is in short supply.

It is interesting to note that in 1942 it took 53 lb. *less* cereal to rear a pig than it did in 1941, and that that pig weighed 17 lb. more. Possibly there was more grazing available in 1942 and also the oats fed in 1941 may not have aided the growing pig to any extent. This, together with increased size of litters, and increased price per lb., has resulted in the value obtained per bushel of wheat fed being increased by 1s. to 5s. 6d. per bushel.

From the results obtained during the two years under review it would appear that a breeding sow having two averaged sized litters per year requires approximately 50 bags of wheat for herself and her two litters per year, providing that she and her litters are given some type of protein concentrate.

South-west view of yards. Note shade trees planted and shelter shed built on to back of each farrowing pen. Fencing comprising ringlock and steel posts, gives satisfactory service.

The results obtained by Mr. K. Giles are very satisfactory from all points of view and are such as could be obtained by other farmers raising pigs in the wheat-belt provided they give their pigs the necessary care and attention.

Thanks are due to Mr. Giles for the excellent manner in which he has kept his records.

Lime in Agriculture.

NOT A SUBSTITUTE FOR SUPERPHOSPHATE.

H. G. Cariss, Agricultural Adviser, and G. H. Burvill, Assistant Plant Nutrition Officer.

Since Nauru and Ocean Island in the Pacific, and Christmas Island in the Indian Ocean, fell into Japanese hands, the supplies of phosphatic rock for the manufacture of superphosphate in Australia have been considerably curtailed. Less than half of the normal out-put of super is now available, and in addition, because of the lower grade of the rock available, the superphosphate has been reduced in grade from 22 per cent. to 18 per cent. phosphoric acid (P_2O_5).

To obtain the most efficient use of the available superphosphate in the national and individual interests, a rationing scheme is in operation and the amounts allotted for many crops are far below those normally used. In view of these restrictions, farmers are looking for some substitute to make up the deficiency, especially as they feel that crop failures may result from the use of the reduced amounts. The need for superphosphate is very general in Western Australian agriculture. However, where the land has been previously fertilised for a number of years, crop failure is not likely to occur with the smaller dressings, although returns per acre may be reduced somewhat depending on the soil type, seasonal conditions, and the previous history of the area concerned. (Teakle and Cariss (1943).)

From the many inquiries received, it appears that quite a number of farmers are of the opinion that lime is the solution to their problem and that by applying this material they can make up the deficiency in their superphosphate supplies. Lime, however, definitely cannot take the place of superphosphate. It is a source of calcium, the important plant food which is also contained in super, but it does not supply any phosphate (phosphoric acid) which is the most valuable fraction of superphosphate.

Lime is not regarded as a fertiliser in the ordinary sense of the word, but is termed a soil amendment or ameliorator. It is widely used in agriculture in many parts of the world on sour or acid soils to reduce soil acidity, and to effect important changes in the chemical, physical, and biological conditions of the soil. In the agricultural areas of this State soils with an acid reaction are very common and extensive, particularly in the higher rainfall parts, but although many experiments have been carried out over a number of years to test the effect of lime, they have, in general, shown no conclusive benefit. On certain sandy and swampy types in the south coastal districts between Nornalup and Albany, dressings of lime have proved an advantage. There may be other districts where restricted local areas will show similar benefits, but the general use of lime, even on the main pasture soils of our south-west districts which are mostly slightly acid in reaction, cannot be recommended.

When lime is used for soil improvement it is applied either as quick lime, slaked lime or ground limestone. Lime-sand, which is a naturally occurring and finely divided form of carbonate of lime, is available in a number of coastal areas of the State and was available from the Railway Department some years ago from Boranup. Applications of lime are made at rates varying from 5 cwt. up to several tons per acre, and hence it needs to be available at relatively low prices for agricultural use.

It is possible that further investigation may show advantages in the use of lime in this State, for recent scientific research has indicated that some soils which "fix" phosphates very firmly so that they are not easily available to growing plants may release this phosphate for plant growth more readily if they are treated with basic materials such as slaked lime. It is known that only a small part of the phosphate added to our agricultural soils as dressings of superphosphate is absorbed by the crop or pastures. The balance remains "fixed" in the surface soil. After a number of years of cropping or topdressing, this "fixed" residue becomes considerable and experiments are now under way to see if the use of slaked lime can make any of this "fixed" phosphate available.

When both lime and superphosphate are to be applied to the same area it is usually recommended that the two should not be mixed together but that the lime should be applied some time, four to six weeks, prior to applying the super. In some cases, however, mixing may not be a disadvantage, as is shown by the results of an experiment with super-lime mixtures conducted at three centres in the wheat-belt last season and reported by Burvill and Cariss (1943) in this issue. Also, basic super, which is a mixture of about 80 parts of super with 20 parts either of ground limestone or of slaked lime, is used in agriculture and is favoured by some farmers in this State. The amount of lime used in these cases is small compared with dressings normally used to correct soil acidity. Further experiments are being conducted this year at a number of widely separated centres to test the value of various mixtures in which the super may be expected to become reverted to less soluble forms. The mixtures include serpentine superphosphate* from New

*Serpentine super is made by mixing three parts of freshly made superphosphate with one part of ground serpentine rock. Serpentine is a silicate of magnesium, as is also soapstone, and both are closely related to talc.

Zealand and mixtures with ground limestone and powdered soapstone obtained in this State.

As stated earlier, there is no evidence to indicate that the use of lime on pasture and crop lands in this State can be generally recommended. If any farmer wishes to try the effects of lime, strips across a paddock should be treated and intervening strips, carefully pegged and noted, left as check plots. Lime in the form of quick lime, slaked lime, ground limestone or lime sand should be used at varying rates from 5 cwt. to two tons per acre.

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Experiments with Micro-Elements for the Growth of Crops in Western Australia.

VII.—THE EFFECTIVENESS OF VARIOUS TYPES OF COPPER FERTILISERS FOR POTATOES AT BORNHOLM, ALBANY.

By

L. J. H. Teakle, and E. T. Morgan.

SUMMARY.

In view of the widespread demand for copper-containing fertilisers in Western Australia, investigations have been instituted to determine whether copper ore produced locally may be used instead of the refined, granulated bluestone which has proved satisfactory in the past.

The experiments have compared the effects of bluestone, oxidised copper ore, and roaster residues (another copper-containing compound) on the growth of crops on copper deficient soils. That reported below relates to the merits of these substances for the growth of potatoes on a copper deficient semi-swamp at Bornholm, near Albany.

In general, copper-containing fertilisers improve yields. Under the conditions of the experiment, of the three types used, the copper ore proved most effective for the correction of the deficiency. A suitable dressing is of the order of magnitude of 2½ lb. of copper per acre, which is equivalent to 10 lb. of bluestone.

Copper ore can be recommended for general use in the correction of copper deficiency in place of bluestone, except on certain types such as marly soils, which are of restricted distribution in the coastal districts.

1. INTRODUCTION.

Farmers in many parts of Western Australia have become interested in the use of copper-containing fertilisers as a means of improving the growth and quality of crops and pastures. Bluestone, or copper sulphate, containing 25

per cent. copper, has been used most generally in the past, and in 1942, approximately 200 tons were sold for fertiliser purposes in this State. This is a highly refined product and is fairly expensive. On this account, endeavours have been made to secure a substitute obtainable locally at the reduced cost per unit of copper.

To this end, oxidised copper ore from certain mining districts and a by-product of the fertiliser works known as roaster residues, have been tried. The oxidised copper ore generally contains from 10 to 20 per cent. copper and the roaster residues from 1 to 2½ per cent. copper. The roaster residues contain from 2 to 3 per cent zinc.

Experiments and general observations indicate that up to about 10 lb. of bluestone per acre is adequate for most crops and the effect of such a dressing continues over several seasons.

This experiment was designed to determine the relative value of bluestone copper ore and roaster residues supplying equivalent amounts of copper for the growth of potatoes. The oxidised copper ore was obtained from Ravensthorpe and the roaster residues from the Cuming Smith-Mt. Lyell Farmers' Fertilisers Limited works at Bassendean. The area of potato land for the experiment was made available through the courtesy of Mr. R. T. Wolfe of Bornholm.

2. THE SOILS.

The area of semi-swamp land selected for the experiment had been used for the production of potatoes in past years until yields had become very unsatisfactory and tubers showed malformations, such as a type of stem end rot and unusual shapes, which are now associated with copper deficiency. During the last 11 or 12 years the land had been under pasture, of which the chief species was *Lotus major*.

Over the bulk of the area selected for the plots, the soil was of a grey sandy type with calcareous material, probably coastal limesand, in the subsoil. At places the calcareous material appeared at the surface. Five blocks of the experiment were on this type. The remainder of the area was wetter and on this portion the soil may be described as a blackish organic loam. The sixth block of the plots was on this type, which proved very much more productive under the dry conditions prevailing than the more general sandy type.

The chemical properties of these soils are represented by the information in table 1.

TABLE 1.

CHEMICAL COMPOSITION OF SOILS REPRESENTATIVE OF THE PLOTS.

Serial No.	Depth. (ins.)	Description.	pH.	Organic C.	N.	C/N. Ratio.	P_2O_5.	K_2O.
1.—GREY SANDY TYPE—				%	%		%	%
3439	0–10	Grey humous loamy sand	5·31	2·35	·137	17·1	·057	·004
3440	10–18	Dark grey loamy sand	6·56	1·16	·061	19·0	·019	·002
3441	18–26	Khaki brown calcareous sand	7·84	·70	·039	18·0	·009	·002
2.—BLACKISH ORGANIC LOAM—								
3442	0–10	Dark grey humous sandy loam	6·90	8·58	·578	14·8	·161	·012
3443	10–19	Blackish humous loam	6·86	4·88	·314	15·5	·076	·013

The soils are low in essential requirements such as phosphate and potash and nitrogen. The grey sandy type is exceptionally low in these ingredients. There is some evidence of phosphate accumulation in the surface, no doubt due to past superphosphate applications. The blackish, organic loam is also very low in potash but is somewhat richer in phosphate and nitrogen. It shows a similar accumulation of phosphate in the surface layer. The grey sandy soil is moderately acid at the surface but alkaline in the calcareous subsoil. The other soil is approximately neutral.

The moisture relations proved most favourable on the blackish organic loam and under the dry summer conditions prevailing in 1941-42 the growth was very much superior to that on the grey sandy type and the yield was heavy. On the sandy type the crop was much lighter and appeared to suffer from moisture deficiency during the growing period.

The land had been satisfactorily prepared for planting, having been ploughed and twice cultivated with a rotary hoe. For planting, furrows were opened up with a double mould board plough. Round seed supplied from the Denmark Research Station was planted in the furrows with the special fertilisers.

The weather conditions at planting were favourable. During the growing period the rainfall was scanty and much below normal.

The records for Denmark, the nearest Recording Station were as follows:—

Month.	1941–42.	General Average.
	points.	points.
November	131	181
December	35	140
January	146	126
February	45	135
Total	357	582

Only 16 points fell from March 1–9, 1942.

These figures indicate a deficiency of 2¼ inches below that normally expected in the growing period.

Unusually hot winds accentuated the dry weather conditions by accelerating the rate of loss of moisture and caused some damage from sand blast.

The grey sandy soils were less able to stand up to the dry weather conditions than was the blackish organic loam which offered far more favourable moisture conditions.

3. *The Experiment.*

Six treatments were tested in the experiment using a 6 x 6 Latin Square design. As control (Treatment A), potato manure at the rate of 12 cwts. per acre and supplying 40 lbs. of nitrogen, 212 lbs. of P_2O_5 and 64 lbs. of K_2O was used. All other treatments were in addition to this control dressing of potato manure and were as follows:—

Treatment B.—Bluestone 10 lbs. per acre, equivalent to 2.5 lbs. of copper.

Treatment C.—Oxidised copper ore 14 lbs. per acre, equivalent to 2.5 lbs. of copper.

Treatment D.—Oxidised copper ore 28 lbs. per acre, equivalent to 5 lbs. of copper.

Treatment E.—Roaster residues 100 lbs. per acre, equivalent to 2.5 lbs. of copper.

Treatment F.—Roaster residues 200 lbs. per acre, equivalent to 5 lbs. of copper.

These substances were thoroughly mixed with potato manure and spread by hand in the planting furrow with the seed.

It was not possible to make detailed examinations during the growing season but it was observed that the copper treatment generally improved the top growth. The plots receiving no copper showed the usual trailing habit of growth, characteristic of copper deficient soils, and were a marked contrast with the others which were normally erect and vigorous.

When ready to harvest, the potatoes were dug by hand, and the tubers from each plot sorted into first grade and rejects for the determination of yield and quality data.

The results are summarised in Table 2.

TABLE 2.

YIELD OF POTATOES WITH VARIOUS TYPES OF COPPER-CONTAINING FERTILISERS AT BORNHOLM.

Planted—6th November, 1941.
Harvested—9th March, 1942.

Fertiliser.	Yie'ds (tons per Acre).		Percentage of First Grade Tubers.
	First Grade Tubers.	Total.	
A. Control, Potato Manure, 12 cwts. per acre	3·8	5·6	68
B. Potato Manure plus bluestone 10 lbs. per acre ...	4·3	7·2	60
C. Potato Manure plus copper ore 14 lbs. per acre ...	5·7	8·4	68
D. Potato Manure plus copper ore 28 lbs. per acre ...	5·9	8·9	66
E. Potato Manure plus roaster residues 100 lbs. per acre	5·0	7·9	63
F. Potato Manure plus roaster residues 200 lbs. per acre	4·9	7·7	64
Difference for Significance P = ·05	0·94	1·2	...

The general effect of copper in improving the yield of potatoes is brought out by the consideration of the yields of first grade tubers and the total yields. It is difficult to explain why the yield of first grade tubers from the bluestone plots was not significantly better than the potato manure alone. However, the data for the total yield were consistent and indicated a significant improvement with bluestone as well as with other copper-containing fertilisers.

It is of considerable interest that the copper ore has given the best yields throughout. The statistical analysis indicates that it was consistently superior to the bluestone. While this conclusion must be accepted with caution it may be taken to indicate that, on copper deficient soils of this type, the copper ore may be used with confidence in place of bluestone. The roaster residues have proved effective but were not superior to the copper ore.

Small applications of copper are effective. It appears that copper fertilisers equivalent to 2½ lbs. of pure copper per acre are adequate to supply the copper needs; double the rate of application of copper ore and roaster residues did not improve the returns.

The copper treatments appear to have had little effect, in this instance, on the appearance or apparent quality of the potatoes. There were a few specimens of spindle- and crescent-shaped, and pointed tubers and a little evidence of stem end rot throughout the plots, irrespective of treatment. It is thought that the dryness of the season was in large measure responsible for the unsatisfactory shape of some of the tubers produced on a soil of low moisture capacity. Although the proportion of first-grade tubers from the controls was at least equal to that from the plots receiving copper, in general, it seemed that the control plots were most affected. This would indicate that the copper has improved somewhat the capacity of the plants to withstand drought and to secure moisture from the soils under the dry conditions prevailing, an observation which correlates with the known effect of copper fertilisers in improving the rooting systems of plants generally.

The response to copper was confined to the grey sandy soil type. On the blackish organic loam at the south end of the plots, the sixth block produced a good crop—approximately 7½ tons of first-grade potatoes per acre—irrespective of treatment, indicating that on this better class soil there was no apparent response to copper in this first crop after so many years of pasture. It is most likely, however, that continued cropping will induce evidence of copper deficiency on this soil type.

It may be concluded that on the grey sandy semi-swamp land at Bornholm copper deficiency of potatoes occurs and may be corrected by the use of copper-containing fertilisers. Oxidised copper ore has proved very effective and may be used instead of bluestone. An adequate dressing appears to be one which supplies up to 2½ lbs. of pure copper—the equivalent of 10 pounds of bluestone per acre.

It seems that oxidised copper ore may be used very generally for correction of copper deficiency in Western Australia. However, there is evidence that it is of little value on certain types such as the marly swamp soils which occur in restricted areas in coastal regions. On these soils, probably owing to their calcareous nature, observations indicate that bluestone is much more effective.

VIII.—EXPERIMENTS TO DETERMINE THE EFFECTIVENESS OF DIFFERENT SOURCES OF COPPER AND THE RESIDUAL VALUE FOR CEREALS ON COPPER DEFICIENT LAND AT DANDARAGAN AND GINGIN.

L. J. H. Teakle.

1.—INTRODUCTION.

Previous papers in this Journal (Teakle, Turton and Throssell, 1940; Teakle, Thomas and Turton, 1941; Teakle, 1942) have given proof of the spectacular effect of copper-containing fertilisers for cereals on one soil type at Dandaragan and have indicated a substantial effect on the typical red sandy red gum country at Dandaragan and Gingin. A variety of copper-containing substances has been

used and all appear to be similar in their effect. Applications of the order of magnitude of 5 to 10 lbs. of bluestone per acre seem to be adequate and equally as effective as heavier dressings. This is equivalent to 1¼ to 2½ lbs. of pure copper per acre.

The investigations here reported are a continuation of those already discussed and consist of seven experiments carried out at Gingin and Dandaragan using oats as the crop in 1941 and wheat in 1942.

The objects included—

(a) The effect of repeating the application of bluestone with subsequent crops.

(b) A further comparison of the effects of bluestone, copper ore, roaster residues, and a line of furnace cinders obtained from Melbourne, supplying a range of amounts of copper.

(c) The effect of copper carbonate pickle on the growth of wheat on acutely copper deficient land.

Six of the experiments were carried out on acutely copper deficient soils on Mr. J. A. V. Brown's property, "Bidgerabbie," Dandaragan. As previously described these soils are light sandy loams containing a large proportion of diatomaceous fragments in the surface horizons. Clay accumulation and diatomite occur in the subsoil layers.

The seventh experiment was on the red sandy or loamy sand soils (grouped as Whakea sands in the Gingin district), on the property of the late Mr. V. G. Rennie, "Moondah," Gingin. On this site the soil ranged from a deep sandy phase of low fertility on the eastern half of the plots, to a stony and gravelly loamy sand phase on the western half, which had proved fairly productive of cereals.

At Dandaragan, on certain of the experiments, there was competition with weeds, of which silver grass and wimmera rye grass were the most serious. Cut worm destroyed portions of the wheat in 1942 on the area used for determination of the effect of copper carbonate pickle.

Wild radish (*Raphanus raphanistrum*) was a serious weed at Gingin.

2.—THE EXPERIMENTS.

These experiments represent the continuation and conclusion of the work commenced in 1939 and reported in the papers mentioned above.

In 1941, one experiment was laid down on the site used in 1939 for the experiment on Mr. Brown's property, Dandaragan, with different rates of bluestone and a micro element mixture. Each plot consisted of two drill widths, so that it was possible to arrange that, in 1941, half of each plot (one drill width) received a repetition of the copper fertiliser used in 1939 and the other half superphosphate only. Mulga oats was selected for the crop. This modification of the layout would give an indication of the residual value of the original copper treatment.

Unfortunately, the oats shed rather badly in 1941 and it was feared that small differences in grain yield due to the differential treatments of the plots might have been obscured. In consequence, these were sown again in 1942, using Ranee wheat and superphosphate only on all plots.

A second experiment on land adjoining this site, which had never received copper in the past, was laid down in 1941, using Mulga oats as the crop and a variety of copper-containing compounds. Bluestone, copper ore, roaster residues,

and a line of copper-containing furnace cinders kindly supplied by Mr. B. Perry of Cuming, Smith and Mt. Lyell Farmers Fertilisers, Limited, Melbourne, were compared with a view to ascertaining the value of copper from different sources when applied at a range of rates of copper. The growth of this area was very satisfactory, but shedding was general and it was thought that differences in appearance of the plots apparent to the eye were not revealed by the harvest yields owing to this trouble. In consequence, this area was sown with Ranee wheat in 1942, using superphosphate only as the fertiliser for each plot.

Table 1.

Yields of Oats and Wheat on plots established in 1939 *on Mr. J. A. V. Brown's property "Bidgerabbie," Dandaragan. Half of each plot received repetition of the micro-element in* 1941 *and the other half superphosphate only. Superphosphate only was used in* 1942 *on all plots.*

No.	Fertiliser Treatments.			Yield of Grain.		
	Year.	Super-phosphate.	Bluestone.	Oats, 1939.*	Oats, 1941.	Ranee Wheat 1942.
		lbs. per acre.	lbs. per acre.	bus. per acre.	bus. per acre.	bus. per acre.
A	1939 ...	112	*nil*	*nil*		
	1941 ...	112	*nil*		9·7	
	1942 ...	70	*nil*			5·9
B (i) ...	1939 ...	112	5	45·5		
	1941 ...	112	5		26·3	
	1942 ...	70	*nil*			12·6
(ii) ...	1939 ...	112	5			
	1941 ...	112	*nil*	...	24·1	
	1942 ...	70	*nil*			13·2
C (i) ...	1939 ...	112	15	45·6		
	1941 ...	112	15		23·8	
	1942 ...	70	*nil*			14·6
(ii) ...	1939 ...	112	15			
	1941 ...	112	*nil*	...	24·5	
	1942 ...	70	*nil*			15·0
D (i) ...	1939 ...	112	30	50·7		
	1941 ...	112	30		24·8	
	1942 ...	70	*nil*			12·4
(ii) ...	1939 ...	112	30			
	1941 ...	112	*nil*	...	26·3	
	1942 ...	70	*nil*			14·3
E (i) ...	1939 ...	112	Mixture†	49·2		
	1941 ...	112	Mixture		25·2	
	1942 ...	70	*nil*			13·0
(ii) ...	1939 ...	112	Mixture			
	1941 ...	112	*nil*	...	26·3	
	1942 ...	70	*nil*			13·7

* Yields given in this column are the composite from both sections of the plots.

† Mixture contained Bluestone (15 lbs. per acre), Manganese Sulphate (15 lbs. per acre), Zinc Sulphate (5 lbs. per acre), Borax (5 lbs. per acre), Iron Sulphate (20 lbs. per acre), and Magnesium Sulphate (20 lbs. per acre.).

TABLE 2.

Yields of Oats in 1940 and of Ranee Wheat in 1942 on plots first planted in 1940 with a range of Copper-containing compounds at various rates. The Copper treatments were applied with Superphosphate in 1940. In 1942 the Wheat was sown with Superphosphate only except on one treatment where Bluestone was again applied.

Treatment.	Yield of Grain.			
	J. A. V. Brown, Dandaragan.		V. G. Rennie, Gingin.	
	Oats, 1940.	Wheat, 1942.	Oats, 1940.	Wheat, 1942.
	bushels per acre.	bushels per acre.	bushels per acre.	bushels per acre.
A. Superphosphate (112 lbs. per acre, 1940; 70 lbs. per acre, 1942)	*nil*	*nil*	17·1	9·2
B. Plus Bluestone (1 lb. per acre, 1940) ...	10·1	4·3	...	...
C. Plus Bluestone (2½ lbs. per acre, 1940) ...	17·0	8·5	...	...
D. (*a*) Plus Bluestone (5 lbs. per acre, 1940)	20·4	9·6	18·8	9·5
(*b*) Plus Bluestone (15 lbs. per acre, 1940)	...	...	21·2	9·9
E. Plus Dissolved Copper Ore equivalent to Bluestone (5 lbs. per acre, 1940)	28·4	10·0	19·6	12·6
F. Plus Dissolved Copper Ore equivalent to Bluestone (15 lbs. per acre, 1940)	31·1	11·6	23·2	11·7
G. Plus Copper Ore equivalent to Bluestone (15 lbs. per acre, 1940)	30·9	12·5	24·8	12·5
H. Plus Roaster residues equivalent to Bluestone (16 lbs. per acre, 1940)	30·1	11·1	19·6*	9·9
J. Plus Bluestone (5 lbs. per acre, 1942), Bluestone only (15 lbs. per acre, 1940)	23·9†	11·1	19·7*†	9·8
K. Plus Cu, Mn, Zn, B, Fe, and Mg in 1940 ...	...	...	16·1	10·7
Difference for Significance P = ·05 ...	3·5	2·6	...	...

* Yield from one plot lost. † No superphosphate in 1940.

The site of the experiment on Mr. Brown's property, sown in 1940, was also cropped in 1942 using Ranee wheat. This experiment included a range of copper-containing compounds and was sown with superphosphate only in 1942, with the exception of one treatment. On this treatment, which had received 15 lbs. of bluestone per acre without any superphosphate in 1940, the wheat was fertilised with a mixture of superphosphate and bluestone. Bluestone was applied at the rate of 5 lbs. per acre with the wheat crop to measure the effect of the additional application of copper in 1942. A similar experiment had been carried out on the late Mr. V. G. Rennie's property, Gingin, in 1940. This site was likewise sown again in 1942 using Nabawa wheat. As in the case of Mr. Brown's experiment, superphosphate only was used on all plots except those which had received bluestone only in 1940. In 1942 the plots under this treatment received superphosphate and bluestone.

To test the effect of copper carbonate pickling a simple experiment was laid down on Mr. Brown's property, adjoining the main blocks of plots. Pickled wheat was sown with and without bluestone as a fertiliser and the growth observed during the season. Unfortunately, web worm (*Sclerobia tritialis*) severely attacked this area and harvest returns could not be obtained. The pickled wheat, however,

suffered severely from copper starvation where sown with superphosphate only. Apparently the copper carbonate pickle had little or no effect in correcting the deficiency under these conditions.

The seasonal conditions in 1941 and 1942 were not as favourable as in 1939 and yields were not high. However, the results have been conclusive and this experimental area will not be continued with as there is evidence of the spread of the effect of the copper treatments to the control plots. Dry autumn weather in 1941 and 1942 at Dandaragan interfered with the preparation of the ground for planting on certain of the experiments and weed control and tilth were not as satisfactory as desirable for experimental work.

On the Gingin plots the light sandy phase gave poor growth, apparently due to nitrogen deficiency which obscured any difference in growth due to fertiliser treatment. The heavier soil phase gave satisfactory crops.

3.—THE RESULTS.

These experiments were harvested by machine at Dandaragan, and at Gingin by cutting drill rows through the plots and thrashing by hand. Grain yields per acre were determined by both methods and the results of the six experiments harvested are tabulated in Tables 1, 2, and 3.

Table 3.

Yields of Oats in 1941 *and of Ranee Wheat in* 1942 *on plots first planted in* 1941 *with a range of Copper-containing compounds at various rates. The Copper treatments were applied in* 1941 *with the Oat crop. Superphosphate only was applied in* 1942 *and was used on all plots at the rate of* 70 *lbs. per acre. In* 1941 *Superphosphate was used on all plots at the rate of* 112 *lbs. per acre.*
Experiment on Mr. J. A. V. Brown's property, Dandaragan.

Treatment.	Yields.	
	Oats, 1941.	Wheat, 1942.
	bush. per acre.	bush. per acre.
A. Superphosphate only (112 lbs. per acre, 1941 ; 70 lbs. per acre, 1942)	3·3	*nil*
B. Plus Bluestone (5 lbs. per acre)	29·2	19·0
C. Plus Bluestone (10 lbs. per acre)	28·2	18·9
D. Plus Oxidised Copper Ore equivalent to Bluestone (5 lbs. per acre)	27·6	18·0
E. As D, but equivalent to Bluestone (10 lbs. per acre) ...	27·2	20·2
F. As D, but equivalent to Bluestone (15 lbs. per acre) ...	27·9	18·9
G. Plus Roaster Residues equivalent to Bluestone (5 lbs. per acre)	30·2	17·4
H. As G, but equivalent to Bluestone (10 lbs. per acre) ...	30·9	20·7
J. As G, but equivalent to Bluestone (15 lbs. per acre) ...	28·9	20·5
K. Plus Melbourne Cinders equivalent to Bluestone (10 lbs. per acre)	29·2	19·2
Difference for Significance P = ·05	...	1·6

Study of these data show that with respect to these soil conditions:—

(i) The optimum dressing of copper-containing fertilisers appears to lie between limits equivalent to 5 to 10 lbs. of bluestone per acre. There is some indication that the optimum amount varies slightly with the season and the soil type. Oxidised copper ore, roaster residues, and furnace cinders containing

equivalent amounts of copper appear equally effective with respect to grain yield of oats and wheat. Dressings of 1½ to 2 lbs. of bluestone per acre have proved remarkably effective on the acutely deficient soil at Dandaragan and the effect persists in the second crop. However, these amounts proved inadequate to eliminate the foliar symptoms of copper deficiency or to produce optimal growth and grain yield.

(ii) The effect of the initial dressing of bluestone or other copper fertiliser has persisted over several crops. No advantage in yield of grain has been obtained by repeating the dressing with the second crop and in one case with the third crop of cereals.

It may be noted that the half plots receiving two dressings of bluestone each at the rate of 30 lbs. per acre gave consistently lower yields of wheat in 1942 than the halves receiving only one application of 30 lbs. per acre in 1939. The difference was small and not significant according to statistical treatment, but it may be indicative of possible harmful effects due to the accumulation of copper applied in several dressings at high rates.

Certainly there is no need to use heavy or continuous applications of other copper fertiliser under the conditions investigated at Dandaragan or Gingin. One small dressing will effectively maintain the production of cereal grain for several years. Whether the composition of the pasture will be maintained without annual dressings has to be determined from the results of other experiments already in progress.

(iii) Differences on the red sandy country on Mr. V. G. Rennie's property at Gingin were small. Copper deficiency is not acute on this class of country, but there is no doubt that its copper status is sub-optimal. On the lighter soil phase, where it seemed that nitrogen deficiency obscured fertiliser effects, the growth of the crop was poor and no effect from copper treatment was apparent. The heavier and more gravelly soil phase, however, produced a much more satisfactory crop and the plots which had received no copper were distinctly inferior in appearance and in yield.

At the time of sowing the wheat in 1942, small areas of first early subterranean clover were planted. Where the wheat made good growth on the heavier soil phase, the subterranean clover suffered from competition and made relatively poor growth. On the lighter soil the wheat was poor but the clover was satisfactory except on plots receiving no copper. Analyses of the leaves and petioles of the subterranean clover from these plots are as follows (figures are p.p.m. of copper on the dry basis):—

Soil Phase.	Fertiliser.			
	Superphosphate.		Superphosphate plus Bluestone.	
	No.	p.p.m. Cu.	No.	p.p.m. Cu.
Whakea Sand—				
Sandy phase	209	2·2	210	7·5
Loamy Sand phase	211	5·1	212	12·4

These analyses indicate acute copper deficiency on the sandy phase and show the effect of the bluestone in raising the copper content. The loamy sand phase would seem to be, at most, mildly deficient in copper judging from the analysis

of the subterranean clover but, as remarked above, showed distinct response in growth of wheat where copper had been used. There is some evidence that the first year growth of subterranean clover is not always a reliable indication of the copper status of the soil. Analyses will be obtained in 1943 to determine the copper content of the subterranean clover, re-establishing itself on these sites.

4.—DISCUSSIONS AND CONCLUSIONS.

The results reported above amplify the information already obtained regarding the value and use of copper-containing fertilisers. Apparently copper is of paramount importance under the conditions of these experiments.

There is some evidence that some other element may also be a factor in short supply and that fertilisers containing it as a supplement in addition to copper may improve the growth of the crop or pasture and possibly the nutritional value for stock. Mixtures including iron, magnesium, manganese, zinc and boron used in these experiments have failed to indicate benefit from extra supplements. However, where roaster residues have been used in a number of instances, the growth and appearance of the oats have been superior to the other treatments supplying a similar amount of copper. For instance, in the 1941 experiment on Mr. Brown's property, on plots fertilised with roaster residues in addition to superphosphate, the oats were taller and the straw more attractive and a brighter golden yellow in colour than elsewhere. However, yields of grain were similar. Owing to the substantial amount of zinc in the roaster residues it was suspected that this element may be exerting a favourable effect on the oats although conclusive yield evidence was not obtained. At the present time there is a certain amount of evidence pointing to a need for zinc on certain Dandaragan and Gingin soils. The zinc content of subterranean clover is low and, at Mungedar, field observations have indicated a greatly superior establishment of subterranean clover where roaster residues have been used in the past. Experiments are being carried out in a number of districts to determine the effect of zinc in addition to copper for the growth of subterranean clover as it seems possible that this species may be more suitable than cereals as an indicator of inadequacy of zinc.

Under the conditions of these experiments the results indicate that oxidised copper ore may be superior to bluestone on copper deficient soils. If this is so, the small additional effect may be due to some undetermined impurities in the crude product. Further investigation is needed on this point. However, these and other results already published do establish the value of the locally mined ore which consists of the surface oxidised portions of copper deposits occurring in many parts of Western Australia.

It may be concluded that on many types of copper deficient soils in Western Australia, a variety of copper-containing fertilisers may be used with equal efficiency. These experiments show that oxidised copper ore and roaster residues, if applied mixed with the superphosphate at rates equivalent to 1¼ to 2½ lbs. of pure copper (5 to 10 lbs. of bluestone) are at least equally as effective as bluestone for the growth of cereals. Copper carbonate pickle, on the other hand, has little or no effect on soils where copper deficiency is acute.

The effect of a single copper dressing lasts for several crops: For instance, the third crop shows no evidence of deterioration even when as little as 5 lbs. of bluestone was used with the first crop, and superphosphate only has been used subsequently. It appears that annual dressings are not necessary for cereals if the first dressing is adequate for optimal results. No exception to this conclusion has yet been observed in experiments in Western Australia, but it must be admitted

that it is possible that some soils may have such a high capacity to absorb the copper that frequent dressings may be necessary. For the maintenance of the copper content of pastures it may be necessary to apply copper-containing fertilisers more frequently than for cereal production. Conclusive evidence in this direction is not yet available but it is hoped that experiments at present in progress will yield the desired evidence at the end of this year.

5.—ACKNOWLEDGMENTS.

Grateful acknowledgment is made of the assistance provided by Mr. J. A. V. Brown and the late Mr. V. G. Rennie in the carrying out of these experiments. These farmers were constant in their interest and at no small inconvenience to themselves arranged for all of the work necessary over a period of years to be carried out efficiently and as required by officers of the Department of Agriculture.

Acknowledgment is also made of the services of the Forestry Department in carrying out statistical treatment of results where possible.

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Cleansing Milking Machines and Care of Rubber-ware.

M. CULLITY, Superintendent of Dairying.

The conquest of Malaya and the Dutch Indies by Japan transferred almost the whole of the natural rubber resources of the world from the control of the United Nations. Great care is being exercised now in all industries where rubber is used in order to reduce the quantity used, and to eliminate waste.

On dairy farms where milking machines are used, the quality of the rubber-ware is of great importance in allowing the production of high quality milk and cream. In the past, farmers have been encouraged to discard their rubber ware and particularly the inflations sooner rather than later, in order to avoid undue contamination of the milk which would result when the rubber begins to perish and absorb butter-fat and other milk substances. Apart from this, it was emphasised that the inflations should not be used if they were stretched or in other ways showing deterioration, as this would cause a direct loss of milking efficiency.

The position now is quite different: rubber is scarce and every farmer is expected to assist in making it last longer. This can be done by being certain

that it is thoroughly cleansed as probably the greatest damage occurs to rubber through the action of grease and dirt. It is fortunate that the methods which will extend its life also allow the production of milk of high quality. The caustic soda and boiling water method has been recommended for many years as a means of keeping milking machines in a sanitary condition as well as tending to safeguard the life of the rubber tubes and inflations.

The details of this procedure are as follows:—

1. Before milking, draw cold water through all milk tubes and the releaser, so as to prevent the adhesion of milk to the pipes, etc.

2. Immediately after milking, wash all dirt off the outside of the teatcups and rubbers, then draw through each set of teatcups sufficient cold (or preferably warm) water to flush out the milk system. When drawing the water through the set farthest from the releaser, insert a ball of horse-hair in the end of the milk pipe to cause it to travel through to the releaser with the water.

3. Next draw through **each set of teatcups not less than one gallon of boiling water** to which caustic soda has been added at the rate of **not less than 1 to 1½ teaspoonsful per 4 gallons of boiling water.** Distribute the solution as evenly as possible through each set of teatcups.

4. Immediately follow by flushing out the caustic soda solution with two gallons of hot water or one gallon of boiling water for each set of teatcups; the flushing with boiling water helps to dry the rubbers and leaves the milk system dry and sweet.

5. Remove or open the plug or flap from the releaser pipe to allow of free circulation of air.

6. **Next clean the vacuum system** in the same manner as the milk system by drawing through first the caustic soda solution, and next the boiling water which has been circulated through the milk system. Pay particular attention to the cleaning of the pipe connecting the releaser to the vacuum tank, by flooding the releaser to cause the water to travel through to the vacuum tank. This is important.

7. The engine can now be stopped. **Disconnect the two long rubbers** from down-pipe and teatcups and hang in a clean airy place out of the sun.

8. Next disconnect the releaser, wash, rinse and place in a clean dry sunny place, then disconnect the top or bottom half of the vacuum tank and treat in a similar manner. **To be successful these operations must be carried out daily.** This does not dispense with the necessity of dismantling the machine as often as possible so that joints and crevices may be examined and treated.

The Technical Officer attached to the Department of Supply has made the following recommendations with a view to preserving, and so extending, the life of rubber-ware:—

"The greatest enemies of rubber likely to be met in milking machine service are:—

1. Copper from brass cups and fittings.
2. Milk fats.
3. Grease, vaseline and ointments.
4. Sunlight.

Copper, particularly in conjunction with fat, grease, etc., will rapidly soften rubber and make it useless. Therefore, where copper or brass fittings are employed, care must be taken to see that the rubber fittings are regularly removed and cleansed.

After considerable use, many of the copper or brass fittings which have been tinned or plated, lose their covering and the copper is then exposed to the rubber-ware. For the complete satisfaction and protection of the user, it is essential that these parts be replated or retinned as early as convenient, so that economical results may be obtained.

Milk Fats.—Milk fat is gradually absorbed by rubber eventually converting it into a soft sticky mass.

Grease, etc.—Grease and vaseline soften and swell rubber and make it more susceptible to the action of milk fat. The user should therefore endeavour to ensure that as far as possible these or similar substances do not come in contact with rubber fittings.

Sunlight.—Sunlight has a harmful effect on all rubber, as it tends to cause perishing or sun-cracking. All milking-machine goods, when not in use, should be kept away from sunlight.

While the deterioration caused by the first three mentioned substances cannot be prevented, it can be considerably delayed by taking care to see that the rubber fittings are regularly removed and cleansed; the cleansing method recommended is as follows:—

1. Completely dismantle the rubbers and metal fittings.
2. Leave overnight in a cold caustic solution of approximately 5 per cent. strength, i.e., ½ lb. caustic soda to one gallon of water.
3. Next day boil for about one hour.
4. Then rinse in cold water.

This method should be carried out at least every one or two weeks, or more often if considered necessary; such cleansing will wash out all foreign matter, and if the rubber fittings are regularly submitted to this treatment, the extra life obtained will far more than compensate for the additional time involved."

Farmers, however, may not find it convenient to adopt the recommendation regarding the boiling of the rubbers in a 5 per cent. caustic soda solution, but they are advised that attention to the thorough removal of all deposits of dirt or grease is essential. The outside of all tubes should be washed regularly after each milking so that the dirt picked up during milking may be immediately removed.

As an alternative to the boiling of the parts in caustic soda, farmers may remove all rubber-ware from the machine once each week and soak for several hours, say between morning and evening milking, in a strong soda solution which is most effective if used hot.

At the Wallaceville Research Institute, New Zealand, it was found that one heaped tablespoonful of metasilicate of soda per gallon of boiling water was most effective. An alternative solution was one containing three parts of soda ash to half part each of metasilicate of soda and trisodium phosphate. The rubbers are immersed in the boiling solution and left to cool slowly. As indicated in the quotation from the Department of Supply circular better results will be obtained if the solution is kept hot for some time.

After prolonged immersion the rubbers can be removed and thoroughly washed before replacing on the machine.

Cape Tulip.

G. R. W. MEADLY.

SUMMARY.

Two species of Cape tulip, *Homeria collina* (Thunb.) Vent. and *H. miniata* Sweet, native to South Africa, are now serious weeds in many parts of Australia. They were introduced originally as garden plants.

Both species are toxic, all parts of the plant being harmful, both when green and dry. A glucoside and an alkaloid have been isolated from different species of *Homeria*.

Stock accustomed to grazing on areas infested with Cape tulip are seldom affected, probably because they avoid the plant. The most serious losses have been experienced among animals brought from a district free of Cape tulip to one in which this weed occurs in quantity.

Chemical sprays have proved unsuccessful and the most effective control measures are grubbing and ploughing. The time for carrying out these operations is governed not so much by the seeding of the weed as the formation of new corms and cormils. This usually commences at the beginning of August.

INTRODUCTION.

Cape tulip is the name applied to *Homeria collina* (Thunb.) Vent. and *H. miniata* Sweet, two species which are widespread in this and other States of Australia. Both are native to South Africa where several other species also occur.

As early as 1859 *H. collina* was catalogued as a garden subject in the Adelaide Botanical Gardens and by 1890 both species were established as weeds in South Australia, Victoria, and Western Australia. Their appearance in New South Wales followed shortly after that date.

Cape tulip provides one of many examples of a plant introduced for ornamental purposes soon becoming a serious weed. It has been declared a noxious weed for the entire State.

Although the extent of infestation in some districts makes eradication impossible, much can be done to control Cape tulip in those areas. Where only small, isolated patches occur, however, complete eradication can be effected. Early recognition followed by prompt action can prevent a few plants from originating a heavy infestation.

DESCRIPTION.

Homeria collina has a single, ribbed, grass-like leaf 12 inches or more long arising from a corm (the so-called bulb) which is surrounded by brown fibrous material. The stem is shorter than the leaf and produces a few flowers which are, at first, enveloped by green spathes. Each flower has six equal segments which are usually predominantly pink with a green or yellow base, but are sometimes entirely yellow. The flowers often exceed an inch in diameter. The narrow cylindrical seed vessel opens at the top to liberate numerous brown seeds. The name one-leaved Cape tulip is often applied to *H. collina*.

Homeria miniata has two or sometimes more grass-like leaves and in consequence is often referred to as two-leaved Cape tulip. These arise from a corm around which are formed numerous cormils (small "bulbs"), the whole being surrounded by dark fibrous material. The flowering stem gives rise to a number of flowers which emerge from green spathes. Each flower has six equal segments,

pink in colour with the exception of the yellow base which is often blotched with green. The diameter of the flower seldom exceeds one inch. During the later stages of growth groups of cormils are formed in the angles formed by the leaves and the stem. The seed vessel and seeds are similar to those of *H. collina*.

A. Homeria miniata. Two-leaved Cape Tulip.
B. & C. Homeria collina (C. seed vessel). One-leaved Cape Tulip.
[Drawing by C. A. Gardner.]

DISTRIBUTION.

There are several extensive areas in Western Australia, the main being the Toodyay-Northam-York-Beverley Districts and the area including Osborne Park, Maylands, Cannington, Bayswater and Bassendean. The extent of the weed in these localities indicate that they were sites of early infestations.

Other areas of varying size and density are distributed from Mingenew to Manjimup and as far east as Kulin and Merredin.

TOXIC PROPERTIES.

Cape tulip is not only significant as a weed but as a poisonous plant. Mackenzie (1910) found that the corm of *H. miniata* contains a glucoside, which has a digitalis-like action on the heart, raises the blood pressure, constricts blood vessels, and has an action similar to curare on voluntary muscle. He states that this glucoside is probably the active principle. Rindl (1924) isolated an alkaloid, homeridine, from the dried stems, leaves and flowers of *H. pallida* Baker and states that Dixon found that this alkaloid had pharmacological actions of the circulation similar to those of digitalis.

There is evidence to show that the poison occurs in all parts of the plants irrespective of whether they are fresh or dry.

Pappe (1857) describes a case of poisoning among natives due to eating the bulbs of *H. collina* and there are many references to losses of animals. Deaths are reported most frequently among cattle, although horses and sheep are also affected. A dose of 2 lb. of green leaves caused fatal haemorrhagic gastro-enteritis in a calf in an experiment carried out by Hindmarsh in June, 1929 (Hurst 1942), while Steyn (1934) found that 220 gm. of the fresh bulbs and leaves in the flowering stage caused the death of a full grown sheep about thirty hours after administration. Similar properties can be assumed for *H. miniata*. Filmer (1926) fed two pounds of chopped leaves of this species to a cow which was found dead the next day.

Stock accustomed to grazing on areas infested with Cape tulip are seldom affected, probably because they avoid eating the plant. Even under these circumstances, however, deaths occur from time to time. The most serious mortalities have been experienced among animals brought from a district free of Cape tulip to one in which this weed is present in quantity. On many occasions deaths have occurred within a few hours.

Although, as mentioned previously, in a controlled experiment, Steyn in South Africa killed a sheep with approximately one half pound of the plant, there is no indubitable record of sheep having been poisoned in this State by Cape tulip.

Clarke (1939) describes the symptoms as partly those of an acute gastro-intestinal irritant and partly those of a cerebral depressant or narcotic. Examples of the first are abdominal pain, diarrhoea, and, if large amounts of green leafy material have been ingested, distension of the stomach with gas, the symptoms increasing in severity and resulting in colic, frequent scouring, great weakness and prostration. The nervous symptoms are indicated by dullness and depression.

Deaths may occur rapidly, within twelve hours or less after ingestion, or the animals may linger for several days.

Carne, Gardner, and Bennetts (1926) describe lesions of intense gastro-enteritis and cardiac haemorrhages revealed by a post mortem examination of a bull poisoned by Cape tulip.

POSSIBLE USES.

The leaves of Cape tulip contain a fibre which is considered by manufacturers to be suitable for reinforcing plaster board. Supplies of sisal fibre for this purpose have been disorganised by the war and Cape tulip has proved one of the most successful substitutes. Gathering and retting for this purpose are still in the experimental stages.

PROPAGATION.

Besides producing a large number of seeds, Cape tulip propagates itself vegetatively, the details varying with the species. *H. collina* normally produces two corms of unequal size above the old withering corm, while *H. miniata* may give rise to several corms along with a considerable number of smaller structures known as cormils. Again, in *H. miniata* similar clusters of cormils are formed in the angles between the leaf bases and the flowering stem.

There is no doubt that, particularly in the earlier days of its introduction, much of the spread of Cape tulip was due to its ornamental nature. Home gardeners, with every good intention, gave corms to friends, but this plant seldom remained confined to the garden boundaries and soon became abundant in localities suited to its growth. Even in recent years Cape tulip has been spread by this means.

Other agencies which have played their part in its dissemination include stock and vehicles, machinery, agricultural seeds, packing and nursery products such as balled fruit trees.

There is little risk of Cape tulip seeds occurring as impurities in graded agricultural seeds, but on several occasions both seeds and cormils have been found in subterranean clover burr and threshed, ungraded seed. Apart from any other consideration this provides ample reason for purchasing cleaned seed.

Straw packing represents a potential source of any weed and Cape tulip corms and cormils have been found in soil forming the balls around fruit trees being distributed from a nursery.

CONTROL.

Any control measures carried out against Cape tulip must be designed, not only to prevent seed formation but also to forestall the development of new corms and cormils. Observations carried out by the author in 1930 and subsequent years have shown that the development of new corms commences about the beginning of August. Cashmore (1938) using pot-cultures found that the first evidence of new corm production occurred during August and early in September.

As, normally, full flowering does not occur until mid-September and seeds are not mature until a month or more later, the time of corm, rather than seed formation influences the initiation of control measures.

A successful chemical spray would be a very convenient control measure but unfortunately, various chemicals have been tried in this and other States with little success. Experiments conducted by this Department proved sodium chlorate, atlacide and sulphuric acid to be ineffective, and Davies (1942) reported that the Council for Scientific and Industrial Research after six years of tests with various chemicals failed to secure satisfactory results with Cape tulip along with a number of other perennial weeds.

The only satisfactory means of control are grubbing and cultivation, the latter often being associated with a cropping programme. Where the areas are small or the plants scattered, grubbing is possible, but where appreciable areas are heavily affected, ploughing is more practical. Unless the plants are grubbed at the beginning of August or earlier there is every chance that new-season corms or cormils will have been formed and remain in the soil when the plant proper is removed. When the flowering stage is reached the basal corm development is well advanced and grubbing at this stage often serves to distribute the weed rather than reduce the infestation, unless extreme care is taken to remove the entire plant. All plants grubbed should be destroyed by burning.

The same principle must be applied to ploughing which should be carried out in late July or early August. A further spring cultivation may be advisable, depending on the regrowth of the tulip, and a summer working, designed to expose as many of the corms as possible, has improved results.

In districts where stock are accustomed to the plant and seldom affected by it, good results have been secured, at the same time deriving some return from the land, by sowing an early maturing crop of oats, grazing heavily until the beginning of August and then ploughing. This practice is more suited to the Great Southern than the lower South-West.

Repeated mowing to prevent flowering will arrest the spread of Cape tulip, although no experimental evidence is available to show whether the density of the infestation is reduced by the operation. Chipping with a hoe will also prevent seed formation but is essentially a measure of control rather than of eradication.

Thoroughness and persistence is required for the control of all perennial weeds and Cape tulip is no exception. A few plants allowed to seed will nullify much good work, and repeated inspections to detect further plants represent an important part of any programme directed against this weed. Spectacular results cannot be expected, and any scheme necessitates carrying out systematic measures for a number of years.

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The Rotting of Superphosphate Bags.

L. J. H. TEAKLE* and H. E. HILL.†

1. INTRODUCTION.

Farmers in Western Australia are aware that superphosphate left in contact with the bags for long periods causes severe rotting of the fabric. Not only is the fabric rotted but discolouration occurs and the jute changes from grey to brownish or reddish. With the high grade Nauru and Ocean Island rocks used prior to the loss of these islands occasioned by the war, the superphosphate was mild in its action and if proper care were taken the bags generally could be used subsequently for other purposes if they were washed and dried immediately after emptying. Occasionally, however, the bags suffered severe damage. This usually occurred in trucks delayed in transit during periods of hot weather.

The high quality of the pre-war grades of superphosphate and the comparative freedom from complaints, rendered close investigation of the factors causing the deterioration a matter of little moment. It was generally thought that the damage was due largely to fluorine or hydrofluoric acid, but evidence was scanty. Very fine grinding of the rock preparatory to acid treatment in the factory appeared to reduce the damage and some protection was afforded by dusting the bags with alkaline materials or soaking them in mildly alkaline solutions. A wide range of tests have been carried out over a period of years in the factories using dusts, dips, and sprays. The dusts included powdered limestone, lime, soda ash, finely ground rock phosphate, di-calcium phosphate, plaster of Paris, and gypsum. Solutions of sodium acetate, soda ash, milk of lime, gypsum, superphosphate, plaster of Paris, "Rot Proof," blackboy gum, sugar, bluestone-soda ash mixture, copper naphthalate and sodium silicate, have been used as dips. As a spray, soda ash solution has been tried. It has not been necessary to adopt any of these treatments in practice for superphosphate made from Nauru and Ocean Island rock, so that the practical aspects have not been worked out. However, it is recognised that dips are unsuitable on account of the labour involved in the dipping and drying processes. Sprays and dusts may be used with little expense and could easily be adopted as routine practice if effective. The farmer can preserve his superphosphate bags by washing them immediately after emptying to remove harmful ingredients and by drying them thoroughly before stacking for future use.

During 1941-42, supplies from Nauru Island and Ocean Island were cut off and, to supplement the reserves, rock had to be imported from Egypt. In Egypt, the phosphate rock is mined at a depth of about 1,000 feet, where it occurs as a layer below ground water level. It is likely that the water would be at least slightly brackish and the dried rock would contain a little salt. One sample of Egyptian rock analysed recently contained 0.36 per cent. water soluble chloride. This would correspond to 0.59 per cent. salt as NaCl.‡ This rock is of low grade compared with Nauru and Ocean Island material.

The superphosphate marketed in 1941-42 consisted of a mixture of one part from Egyptian rock and three parts from Island rock. Unexpected difficulties arose. Many cases of very severe damage to bags and to the railway tarpaulins

*Plant Nutrition Officer, Department of Agriculture.

†Supervising Chemist, Government Chemical Laboratory.

‡Analysis by courtesy of Mr. Walker of Cresco Fertilisers, Ltd. Since this paper went to press another shipment of rock has been received. This rock contained 0.39 per cent. water soluble chloride which is equivalent to 0.64 per cent. salt.

covering the consignments occurred during the hot weather of December, 1941, and January, 1942. Complaints were so general that investigations were undertaken to ascertain the cause of the enhanced damage and means of control.

2.—INVESTIGATIONS.

It is well known that bags suffering damage from contact with superphosphate are discoloured brownish or reddish and the fibres become brittle and very much reduced in tensile strength. Factors associated with these changes were subject to considerable investigation. Details of the results will be published in the Journal of the Royal Society which will appear at a later date. This paper constitutes a summary of the results of these investigations.

On the assumption that the excessive damage was due to the increased amount of free acid in the new superphosphate mixture occasioned by the need for extra acid to bring about the guaranteed percentage of water soluble phosphate, the manufacturers early adopted as a control the incorporation of a few per cent. of ground limestone with the superphosphate immediately prior to bagging. This proved quite satisfactory in general and has now become standard practice in all factories. In order to affort added protection to the upper parts of the bags which would be likely to come in contact with the tarpaulin, and where damage has been most apparent, soda ash spray is applied to absorb any acid vapors which may be liberated owing to heating during transport.

The laboratory investigations showed that the superphosphate made from Egyptian rock and which was responsible for the excessive damage, contained a small amount of free hydrochloric acid (spirits of salts). On the other hand, superphosphate made from Nauru and Ocean Island rocks contained practically no hydrochloric acid but liberated a small amount of hydrofluoric acid on warming. Subsequent tests with jute twine showed that hydrochloric acid and hydrofluoric acid in dilute solutions were very damaging to fabric. Even the air above such solutions of these acids caused rapid rotting of the twine. Furthermore, it was observed that the hydrochloric acid at similar concentration was very much more severe than the hydrofluoric acid.

The effect of the superphosphates on the jute fabric proved very similar to that of the pure acids in dilute solution. The severity proved to be closely dependent upon the temperature. The higher the temperature the greater the damage. Experiments showed that the superphosphates containing hydrochloric acid were more damaging at lower temperatures than those which contained no hydrochloric acid but which gave off hydrofluoric acid on warming. The addition of salt (sodium chloride) to the Nauru rock prior to acid treatment in the manufacture of superphosphate rendered the action similar to that of the superphosphate from Egyptian rock. The acid used in making the superphosphate would convert part of the salt into hydrochloric acid. Apparently production of hydrochloric acid occurs in the manufacture of superphosphate from rock containing chlorides (either as salt or other active combination), because the ground rock itself had no effect at all on the jute fabric.

The damage to the jute in contact with the superphosphate made from Egyptian rock was very slight at room temperatures which ranged from 65-80°F. At 110°F—which approximates high summer shade temperatures in the wheatbelt—the fabric was severely damaged and the degree of damage increased as the temperature was raised. After three days and four nights at a constant temperature of 160°F., the fabric was reduced to a condition in which it powdered when being rubbed in the fingers. A temperature of 160°F. is well within the range to which the black bodies will rise rise when exposed to the sun during hot summer

weather. It is readily seen, therefore, that bags in contact with railway tarpaulins under the heat of the summer sun would reach temperatures which would bring about rotting of the bags very rapidly and result in severe damage to the tarpaulins. Severe damage from the Nauru Island superphosphate was not observed until 120°F. was exceeded.

Jute twine suspended in the air above the Egyptian superphosphate also suffered damage of a similar type but the action was less severe and higher temperatures were necessary to cause complete rotting. The damage was observed to be severe when the temperature rose above 140°F. The vapor from superphosphate made from the Nauru rock did not appear severely damaging until a temperature of approximately 160°F. was reached.

There seems to be little doubt that the chief agent causing the excessive damage associated with superphosphate made from Egyptian rock is hydrochloric acid. Hydrochloric acid is highly volatile and the vapor would concentrate in the space above the superphosphate as the temperature rose. Sulphuric acid and free phosphoric acid, which occur in small quantities in all superphosphates, are not volatile except at very high temperatures, and tests with the pure acids in solutions show that they have little or no effect in the vapor phase at the temperatures under investigation.

Table 1 shows the effect of increasing temperature in bringing about excessive damage to jute twine in contact with superphosphate and in the vapor phase above it. From this table it will be observed that Egyptian superphosphate is very much more severe than the Nauru superphosphate and that limestone incorporated with the Nauru superphosphate has practically eliminated damage at temperatures as high as 160°F.

TABLE 1.

EFFECT OF TEMPERATURE ON THE LOSS IN STRENGTH OF JUTE TWINE IN CONTACT WITH SUPERPHOSPHATE AND SUSPENDED IN THE AIR ABOVE IT. TIME OF CONTACT: THREE DAYS AND FOUR NIGHTS.

(Figures give the breaking strain of the twine in lb.)
Undamaged Twine averages 36 *to* 40 *lb. breaking strain.*

Temperature (°F.).	Nauru Superphosphate.		Nauru super. plus 3% Ground Limestone.		Egyptian. Superphosphate.	
	Contact.	In air above.	Contact.	In air above.	Contact.	In air above.
	lb.	lb.	lb.	lb.	lb.	lb.
about 75	32	41	38	*	39	46
104	27	40	37	*	...	...
113	26	35	37	*	15	37
122	18	40	36	*	12	43
131	12	36	34	*	...	...
140	7	33	30	*	1	18
149	9	35	38	*	...	...
158	4	14	36	*	1	9
167	3	8	34	*	...	...
Water soluble chloride as % hydrochloric acid (HCl) in the super.	*Nil*		*Nil*		0·16	

* No damage observed.

3. CONTROL MEASURES.

It has been ascertained that mixing small amounts of finely ground limestone with the superphosphate greatly reduced the damage to jute fabric in contact with it at moderate temperatures. With the superphosphate made from Nauru and Ocean Island rock the protection is good at temperatures as high as 160°F. With the superphosphate made from Egyptian types, however, the incorporation of ground limestone may fail to be effective if the temperature exceeds 140°F. At 160°F.—which temperature may occur at the point of contact between a black railway tarpaulin and the bag on a hot summer's day—the protection may be very small. The damage resulting from over-heating of the top surfaces of the uppermost bags in a truck may be reduced, however, by spraying with soda ash solution, which would absorb acid vapors liberated at increasing temperatures, and by the use of dunnage or other means of keeping tarpaulins from actually touching the superphosphate. Any means which would effect improved ventilation and the removal of the active vapors would be beneficial.

Considerable care must be exercised in the use of ground limestone. If too little is used the protection of the bags will be inadequate; if too much is used the superphosphate will be liable to set hard in the bags. The acids acting on the excess limestone form a mild cement which may cause considerable inconvenience to farmers wishing to use the superphosphate. In the 1942-43 season, a certain amount of trouble was experienced due to both causes.

It appears that the amount of limestone to be added must be carefully adjusted. The lower limit to avoid damage to the bag appears to be about three per cent., and the upper limit above which setting may be serious is approximately five per cent. As a result of this experience, manufacturers are taking every care to ensure correct mixing and it is hoped that, in spite of manufacturing difficulties involved in the use of the inferior Egyptian rock, improved practice will virtually eliminate future excessive damage to bags or the setting of the superphosphate.

Summarised, the measures necessary to reduce damage to superphosphate bags to a minimum include:—

1. Every care should be taken to avoid over-heating of the superphosphate in the bags due to exposure to the sun in hot weather.

2 A small amount of a suitable alkaline substance such as finely ground limestone, should be incorporated with the superphosphate immediately prior to bagging.

3. the surfaces of the topmost bags of superphosphate in the railway trucks should be sprayed with an alkaline solution, such as soda ash, to protect both the bags and the tarpaulins.

4 Delays in transit between the factory and the farm should be avoided as far as possible, particularly in the hot weather.

5. On the farm the superphosphate should be stacked under cover in as cool a place as possible where ventilation is good. Direct exposure to the sun should be strictly avoided and in no case should the stack be adjacent to an iron wall liable to excessive heat by the sun.

6. If the foregoing precautions are observed there should be no undue damage to the superphosphate bags under normal storage. Immediately after emptying, the bags should be washed and dried prior to stacking for future use.

These measures are being generally applied at the present time.

Plant Diseases in the Home Garden.

W. P. CASS SMITH, Plant Pathologist.

BLACK SPOT AND STEM ROT OF PEAS.

This is a very common and serious disease of peas in all parts of the State during the wet winter months. At least three fungal organisms, namely, *Mycosphaerella* sp. and *Ascochyta* spp. may be responsible for symptoms of this general type, but as their life histories are very similar, they are treated here as one.

The main symptoms will be familiar to anyone who has tried to grow peas during winter; the disease becomes obvious by the occurrence of a conspicuous black or purplish streaking of the lower stem portions, together with a very obvious spotting of the leaves and pods. When the disease is severe the basal stem portions may be completely rotted, causing the death of all above ground parts. In this case the black or purplish discolouration completely encircles the stem, and the lesion may extend several inches above ground level. (Plate 1.) On the leaves the spots may take the form of small brown or purplish irregular dots, or they may be large, more or less circular, and concentrically ringed. (Plate 2.)

Plate 1.
Stem rot of Peas. Note blackening of lower stem, and withering of foliage from the base upwards.

Plate 2.
Black spot of peas showing leaf and pod spot stages.

The disease is seed borne, and its appearance in a garden in the first instance can usually be traced to the use of infected seed. Most commercial samples contain a proportion of black spot infected seeds, and these are often badly shrivelled and discoloured with black, brown or purplish blotches. Culling out discoloured and shrivelled seed from the sample will considerably reduce the disease, but as a few infected seeds may be symptomless the disease cannot be eliminated entirely by this means. (Plate 3.)

However, growers can, if they wish, obtain clean seed by planting a special late spring or summer crop for seed purposes, as the black spot disease is only serious on crops grown during wet weather. When saving seed, any pods or seeds showing discolouration should be avoided.

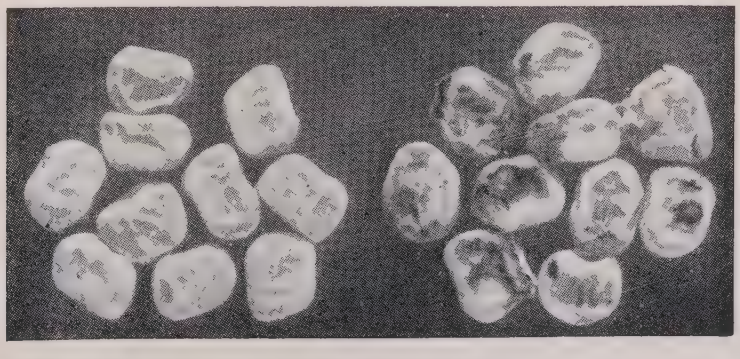

Plate 3.
Good, and inferior quality seed. Black spot and stem rot of peas is often introduced by infected seed; discoloured, cracked, spotted or shrivelled seed, such as that shown on right, should not be planted.

The sowing of infected seed gives rise to diseased plants, and the latter establish infection centres from which the disease is transmitted to healthy plants adjacent by rain splashed spores. Black spot can also persist from one year to the next in diseased crop remains.

CONTROL.

(1) If possible sow only disease free seed harvested from a late spring or summer crop, or if this is unobtainable, carefully handpick and discard all badly shrivelled, discoloured, or cracked seed.

(2) Plant out on land which has not grown peas for two or three years, choosing a sunny, well drained, situation for winter crops.

(3) Inspect plants shortly after emergence and destroy any weakly or spotted specimens.

(4) Support the crop well off the ground with stakes, strings, etc., so that it will dry more quickly after rain.

(5) Immediately the disease is noticed spray with copper containing sprays, covering the stem bases thoroughly, as well as the leaves. Repeated sprayings may be necessary to control the disease during the wet winter weather. Cuprox applied at the rate of 1 oz. in 2 galls. of water is very convenient and suitable for small plantings. For larger areas, Bordeaux mixture, 4 : 4 : 40 strength is recommended. (See Leaflet 536.)

MOSAIC OF PEAS AND BROAD BEANS.

Mosaic of peas and broad beans is caused by a virus which is naturally transmitted by species of aphis.

It is probably transmitted to a limited extent by the seed, and primary crop infection may be due to this cause.

Plate 4.
Pea Mosaic.

On peas, foliage affected with mosaic shows a characteristic mottling of light or yellowish-green and dark green areas, and frequently the mottled areas follow the small veinlets, giving affected leaves a netted appearance. (Plate 4.)

On broad beans the foliage is also mottled and affected leaves are puckered and distorted, and compared with normal leaflets, usually smaller in size. (Plate 5.)

Plate 5.
Mosaic disease on broad bean leaf (right). Healthy leaf on left.

Plants showing the disease at an early stage are stunted, but when late infection occurs stunting is not so obvious.

CONTROL.

1. Plants showing symptoms of the disease shortly after emergence should be rogued out as soon as possible.

2. Keep sap-sucking insects in check by the use when necessary of contact insecticides such as nicotine sulphate.

3. Separate plantings of peas from broad beans and if sowing seed select healthy plants only.

CHOCOLATE SPOT OF BROAD BEANS.

Chocolate spot of broad beans and tick beans occurs yearly during late winter and spring, and its severity depends largely on weather conditions. With continuous rainy weather serious epidemics occur, whereas with dryer conditions it is not so evident.

As the name implies, the disease becomes evident by the occurrence of chocolate coloured spots on the leaves which vary in size from tiny specks up to spots ¼ inch or more in diameter. Brownish streaks also occur on stems and leaf stalks. During wet weather the lesions become so numerous that they coalesce, causing a blighting of foliage, blackening of stems, and in severe attacks, death of whole

plants. (Plates 6 and 7.) Chocolate spot as it occurs locally is caused generally by a fungus (*Botrytis cinerea* Pers.), though a similar spotting of the foliage may sometimes be brought about by sucking insects.

Plate 7.
Chocolate spot of broad beans showing defoliation, stem blackening, and dieback, in final stage.

Plate 6.
Chocolate spot of broad beans showing initial leaf spot stage (inset) and blighting of foliage in later stage.

Other fungi, namely, *Cercospora fabae*, and *Ascochyta fabae*, are also responsible for leaf spotting damage, and the last named fungus has frequently been noticed causing a stem and pod spot. When pods are affected with *Ascochyta fabae* the organism often penetrates into the developing seed immediately below the lesion. (Plate 8.)

CONTROL.

(1) Obtain best quality seed and cull out any blemished, discoloured, or shrivelled seeds.

(2) After emergence rogue out any abnormal looking plants.

(3) Plant on well drained soil types as the disease is much more severe on waterlogged soils.

(4) When the disease appears, frequent spraying with copper fungicides as recommended for black spot and stem rot of peas will give good control.

(5) Plantings maturing in late spring usually escape the disease.

Plate 8.
Stem and pod spot of broad beans caused by *Ascochyta Fabae*.

POTASH DEFICIENCY.*

Prior to the war, troubles due to potash deficiency were relatively rare in this State. Cases investigated by officers of the Plant Pathology Branch were found to be due mainly to unbalanced nutrition caused by an excessively high nitrogen to potash ratio in the applied fertiliser.

They occurred more commonly on light than heavy soil types and were noted in crops of lucerne, cabbage, cauliflowers, and potatoes. On lucerne, suppressed growth or dieback of shoots, after cutting, resulted, while on potatoes and plants of the cabbage family the symptoms were of the type usually referred to by growers as leaf scorch or "rust."

Since the war, however, diseases of this kind have inevitably increased owing to the shortage of potash fertilisers, and believing they were due to parasitic causes growers have in a number of instances applied fungicidal sprays.

To prevent such waste of labour and materials a knowledge of the symptoms is required, especially those shown by plants of the cabbage family and potatoes, which appear to be most subject to this deficiency trouble.

*Written in conjunction with G. H. Burvill, Assistant Plant Nutrition Officer, and L. T. Jones, Agricultural Adviser.

Affected potato foliage is usually ruffled or quilted in appearance, due to a ridging of the tissues between the veins. Later the interveinal tissue takes on a yellowish hue and gradually turns rusty or bronze in colour. Finally numerous dead spots appear in affected leaves which become brittle and rolled upwards. Potatoes appear to be most subject to this trouble during the winter months, and the yield of an affected crop is greatly reduced.

An opportunity was afforded recently to observe the effects of a potash deficiency on cabbages in a controlled experiment at Balcatta. The symptoms in this case were first noticed six weeks after planting, and were as follows:—

> A yellowing was first observed on the tips of the leaves (marginal yellowing) and this extended backwards from the tips or margins, between the veins. Later a "scorch" of the affected areas developed, commencing around the margins, and the dead tissue was brown and brittle. The potash deficient cabbages developed a crinkling of the leaf and were pale green in colour, while those supplied with potash were a deep bluish-green and smooth. (See Plates 9 and 10.)

Plate 9.

Left: Cabbage showing potash deficiency symptoms. Note marginal scorch, yellowing, crinkling, lighter green colour, and smaller size compared with cabbage on right.

Right: Cabbage from same area but supplied with sulphate of potash, 2 cwts. per acre. Note good colour, smooth leaf, and better size.

A side dressing of nitrate of soda two weeks before cutting increased the severity of the leaf scorch symptoms.

Sulphate of potash at the rate of 2 cwts. per acre increased the yield, in this instance, from 20 tons to 30 tons per acre, and the cabbages from the plots so treated showed none of the symptoms described above.

Unless potash deficiency symptoms develop and are recognised at an early stage the trouble is difficult to remedy. A recurrence of the trouble should be guarded against when the area is next planted. Potash fertilisers (either sulphate or muriate of potash) at the rate of ½ to 1 oz. per square yard (= 150 to 300 lbs.

per acre) should be used if possible, but owing to war conditions they are at present almost unobtainable. It is hoped that supplies will be available before long from the alunite deposits of Lake Campion in this State.

Plate 10.

Leaves from healthy and potash deficient cabbages shown in Plate 9. Left to Right: (1) Leaf from cabbage supplied with potash. (2) Leaf showing a yellowing extending backwards from the tip—no potash. (3) Leaf showing a marginal scorch. Note the brown and brittle dead tissue—no potash.

For the commercial grower the control of potash deficiency troubles is extremely difficult under wartime conditions. Only limited supplies are available of organic waste materials containing appreciable amounts of potash, e.g., scouring works wastes and barley combings, and therefore, until supplies of potash fertilisers become available, the heavier soil types, naturally richer in potash, should if possible be utilised for the crops referred to earlier.

In home gardens, however, with much smaller areas there are much greater possibilities of overcoming or avoiding potash deficieney troubles.

Animal and poultry manures, compost, river algae, water hyacinth, ashes, and green manure crops all contain potash, but in amounts which depend on various factors. The food of animals and birds is a major factor since it is the source of the manurial ingredients in the manure. Further, with animals such as horses, cattle, and sheep, over half the potash excreted is in the urine so that manure from stables and sheds will be much more valuable as a source of potash (and incidentally of nitrogen) than that collected from paddocks. With compost and green manure crops, if the plant materials which are composted or dug in are grown on a soil of low potash supplying power they will likewise be low in potash, but will nevertheless provide a useful supplement when dug into a potash deficient soil. Green manure crops may collect potash throughout several feet of soil and this is concentrated in the surface layer when the crop is dug in.

From analyses made in 1942, it has been calculated that a very heavy crop of New Zealand blue lupins (36 tons per acre green) grown without potash fertiliser on the sandy soil round Perth returned, when dug in, potash equivalent to ½ oz. of sulphate of potash per square yard. However, from alluvial soil at Upper Swan the lupins were four times as rich in potash. Likewise compost made from lawn clippings and garden refuse, used at the rate of one four-gallon petrol tin per square yard contained potash equal to ½ oz. of sulphate of potash per square yard.

Ashes are a useful source of potash, but the amount they contain varies with the species of tree or plant burned to produce them and also according to the soil on which these grew.

Even on poor sandy soils potash deficiency should not occur if ashes, organic manures and wastes are conserved and dug in at intervals to the garden beds.

Additions of fertile loam to poor sandy soils will help to remove possibilities of potash deficiency, but the chances of introducing weeds and pests such as Guildford grass and eelworm should not, however, be forgotten.

Gardeners interested in green manuring, or the preparation of compost, should refer to leaflets Nos. 679A, 705, and 671, which are obtainable free of charge from the Department of Agriculture.

FAILURE OF PEAS DUE TO LACK OF INOCULATION.

The peas in the top row, which were innoculated with a nitrogen-fixing bacterial culture before planting, made normal healthy growth. Those in the bottom row were not inoculated and did not grow more than a few inches high. Both rows were planted on the same day on soil which had not grown peas before.

For the healthy growth of peas and other plants of the same family (leguminous plants), it is necessary that the correct strain of these root-nodule forming bacteria is present in the soil. Many garden soils already contain these bacteria so that peas may grow well without artificial seed innoculation. Others, however, do not, and peas grown on such soil, after growing only a few inches, usually turn yellow and die. Gardeners who suspect that failure is due to lack of innoculation should test the effect of bacterial cultures which may be obtained from the Department of Agriculture, Perth.

Pig Raising in the Metropolitan Area.

M. Cullity, Superintendent of Dairying.

Following the outbreak of swine fever in the metropolitan area in October of last year, several thousand pigs were slaughtered with the result that approximately 100 piggeries went out of production. Further, owing to the ban on the use of camp refuse and city garbage, the main source of a cheap foodstuff for the remainder was eliminated. Some concern therefore has been expressed at the future of the industry in the metropolitan area, particularly as it relates to the feeding of store pigs reaching the livestock markets from country areas.

However, bacon pigs of excellent quality can be produced by feeding a mixture of grain with a supplement of meat-meal. The quantity of grain and meat-meal required will depend on whether there are other substances available—such as pasture and root crops, which would reduce the quantity of grain which it is necessary to purchase, or protein-rich foods such as skim-milk, young green lucerne, pasture, peas, etc., which would lower the amount of meat-meal required. It is in most cases profitable, where the land is available, to grow crops which will in this way reduce the need for purchased food.

The following table indicates the value of a number of substances which may be available, expressed as the amount of each which would be equivalent to 1 lb. of grain.

Weights of various foods equivalent to one pound of grain.

8-12 lbs.—Cabbage, cauliflower, melons (15 lb.), pumpkin, kale, kohl rabi, mangols, carrots (7-8 lb.), turnips, apples.

4-6 lbs.—Potatoes, sweet potatoes.

The results of Pig Feeding Trials at Muresk Agricultural College indicate that 10 bushels of wheat are used for each bacon pig reared (inclusive of the grain used for sows and boars). This figure is confirmed by results obtained by Mr. Giles of Doodlakine, reported elsewhere in this Journal.

It is recommended that 10 per cent. of meat-meal be used in the ration—i.e., that 1 lb. of meat-meal be mixed with every 9 lb. of grain. Bone-meal or ground limestone equal to one part in 50 of the mixture should also be used.

From these figures the farmer may calculate the approximate cost of feed for each bacon pig marketed—e.g.:—

	£	s.	d.
10 bushels of wheat @ say 4s. per bushel	2	0	0
66 lb. meat-meal @ say 1½d. per lb.	0	8	3
13 lb. bone-meal @ say 1½d. per lb.	0	1	8
	£2	9	11

This feeding should produce a pig which would be about 135 lb. dead weight and valued at £4 10s. (135 lb.). We therefore have a margin of £2 per pig to cover the other costs entailed in producing—such as the interest on the land and buildings, depreciation of buildings and stock and marketing costs. It is unlikely that these costs would absorb 20s. so that 20s. would be left to cover the cost of labour and profit.

In this way it can be seen that one man marketing 250 pigs would gain a little better than the basic wage: with an output of only 12 pigs per sow per annum, he would require only 20 sows. This is well within the capacity of one man. It has been demonstrated that where facilities are suitable one man can manage 50 sows and their progeny. These sows producing only 12 pigs per year would enable him to market 600 baconers and allow him a substantial income.

In the foregoing calculation a value of 4s. per bushel was adopted. Wheat of f.a.q. quality can be purchased from the Wheat Board at 3s. 3½d. in bulk. Frequently inferior quality wheat, bin damaged, is available at prices much lower.

It is suggested, therefore that it is possible for pig raisers in the metropolitan area to continue their activities even if they have to feed wholly on purchased food.

The following points should be considered by farmers desiring to stabilise their activities under the altered conditions.

1. Select breeding stock of good type and of high prolificacy.
2. Grow as many fodder and root crops as possible to reduce the need for purchased food.
3. Buy wheat at the lowest possible price.
4. Use a protein supplement such as meat-meal in adequate proportion.
5. Use a mineral supplement.
6. Make the piggery convenient so as to enable as many pigs as possible to be handled by one man.

Experiments on the Effect of Adding Ground Limestone and Slaked Lime to the Superphosphate Used for Wheat Growing.

G. H. BURVILL, Assistant Plant Nutrition Officer, and H. G. CARISS, Agricultural Adviser.

SUMMARY.

Experiments were carried out in 1942 at Chapman, Merredin, and Wongan Hills Research Stations with a range of superphosphate-ground limestone mixtures as fertiliser for wheat. Increased amounts of the mixtures were applied to give each plot the same dressing of super. The crops were planted two to four weeks after the mixtures were made up.

The addition of up to 20 per cent. of ground limestone to the super had no effect on yields. A mixture of super and 20 per cent. slaked lime gave a slightly reduced yield at Wongan Hills, but not at Chapman and Merredin.

INTRODUCTION.

Severe rotting of superphosphate bags and railway tarpaulins occurred in many consignments during December, 1941, and January, 1942. The trouble was associated with the use of phosphate rock from Egypt, which had to be substituted in part for the phosphate rock from Nauru, Ocean and Christmas Islands, which—in normal times—is used for superphosphate manufacture in this State.

Fortunately, it was soon found that the addition of a small percentage of ground limestone to the super before bagging greatly reduced the rotting of the bags and damage to railway tarpaulins.

Studies to determine the fundamental cause of the rotting were made and are outlined in an article by Teakle and Hill (1943) in this issue. In this work it was found that at high temperatures (158°F) some samples of super from Egyptian rock were very damaging to jute string unless considerable amounts—up to 12 per cent.—of pure carbonate of lime were mixed with them.

Since the addition of such amounts of basic material to the super was expected gradually to reduce the water soluble phosphate by reversion to less soluble forms, the possible effect on the manurial value of the super came into question. Accordingly, although planting for the 1942 season had already started, experiments with wheat were arranged at the Research Stations at Chapman, Wongan Hills, and Merredin. The object was to compare various mixtures of super and ground limestone as fertiliser for a wheat crop. It was realised that it would not be possible to keep the experimental mixtures for more than a few weeks after mixing before planting.

THE EXPERIMENTS.

The superphosphate used as a basis for the experiments was a mixture composed of 70 per cent. super from Christmas Island rock and 30 per cent. super from Egyptian rock. This had somewhat more Egyptian rock super than most of the super sold early in 1942. The mixed super was supplied by Cuming Smith & Mt. Lyell Farmers Fertilisers, Limited, and through courtesy of that firm was made up into mixtures with 4, 8, 12, and 20 per cent. of ground limestone, and also with 20 per cent. of slaked lime. The ground limestone contained approximately 60 per cent. of calcium carbonate. The mixtures were made up on 15th May, 1942, and were sown on 25th May, 29th May, and 12th June, at Merredin, Chapman, and Wongan Hills respectively. All three experiments were planted on fallowed land which had received several previous dressings of super over a period of years.

The treatments used and the yields obtained are set out in Table 1. All plots, except the no fertiliser plots, received the same amount of super, i.e., increased amounts of the mixtures were applied to allow for the added limestone and slaked lime.

The yield data indicate that in these three experiments the addition of ground limestone or slaked lime to the superphosphate has had little, if any, real effect.

At Chapman the no fertiliser plots gave yields comparable with those from the other treatments. This has also been noted in other fertiliser experiments at Chapman and has recently been discussed in this Journal by Teakle and Cariss (1943). Apparently the Chapman soil has reached a stage of saturation with phosphate where it is able to supply the needs of a wheat crop on fallow.

At Merredin, where the experiment was on heavy land, all treatments receiving super alone, or in mixtures, yielded close to three bushels per acre more than the no fertiliser plots.

On sandplain country at Wongan Hills, yields were lower than at Merredin, but again the use of superphosphate raised the yields by two to three bushels per acre above the no fertiliser plots. Next to treatment A (no fertiliser) the lowest yield was given by the super-slaked lime mixture of treatment G. The difference in yield between treatment G and treatments C and B is probably a real one, and not due to chance variations among the plots.

TABLE 1.

YIELDS OF WHEAT WHEN FERTILISED WITH VARIOUS MIXTURES OF SUPERPHOSPHATE AND GROUND LIMESTONE AND SLAKED LIME.

Randomised Block Experiment—Five Replications.

Fertiliser Mixtures made up 15th May, 1942.	Chapman.	Merredin.	Wongan Hills.
Date of Planting	29th May	25th May	12th June
Date of Germination	3rd June	5th June	24th June
Wheat Variety	Nabawa	Bencubbin	Merredin
Superphosphate (lbs. per acre) in Treatments B to G	60	60	70
Treatment—	Grain Yields—Bushels per acre.		
A. No fertiliser	11·33	20·05	10·88
B. Superphosphate	10·75	23·03	13·65
C. Super. + 4 % ground limestone	10·35	22·98	13·68
D. Super. + 8 % ground limestone	10·98	23·15	12·80
E. Super. + 12% ground limestone	11·12	23·33	13·02
F. Super. + 20% ground limestone	11·63	23·16	13·37
G. Super. + 20% slaked lime	10·22	22·97	12·53
Smallest difference between treatments which may reasonably be considered not due to chance (P = ·05)	*	·36	·91

* At Chapman, all differences may be ascribed to chance variations between plots other than the fertiliser treatments.

CHEMICAL COMPOSITION OF THE FERTILISER MIXTURES.

When the fertiliser mixtures were prepared samples were bottled and kept at the fertiliser works. On 25th May, i.e., the date on which the experiments at Merredin were planted, these mixtures were analysed in the laboratories of Cuming Smith & Mt. Lyell Farmers Fertilisers, Limited, for water soluble, citrate soluble and acid soluble phosphoric acid. It was thought that this data would give some indication of changes in the mixtures by the time the fertiliser was placed in the ground. It is realised, of course, that reactions causing the reversion of water soluble phosphate to less soluble forms could occur during water extraction in the analysis and not during storage. Especially may this have occurred with the super-slaked lime mixture (see Table 2).

Table 2 shows the analyses of the mixtures calculated on the basis of the superphosphate contained in each.

The analyses indicate that even though reactions during analysis may have occurred, a high proportion of water soluble phosphoric acid was still recorded for all the mixtures containing ground limestone. The decreases which occurred were largely accounted for in the increase in the citrate soluble fraction. In the mixture containing 20 per cent. of slaked lime the analysis shows only 2.58 per cent. water soluble with 17.25 per cent. citrate soluble. Whether this represents a change which had occurred prior to analysis it is impossible to determine.

ACKNOWLEDGMENT.

The willing co-operation of Cuming Smith & Mt. Lyell Farmers Fertilisers, Limited, in making up and analysing the fertiliser mixtures is gratefully acknowledged.

Table 2.

ANALYSES OF SUPERPHOSPHATE–GROUND LIMESTONE AND SUPERPHOSPHATE-SLAKED LIME MIXTURES, 10 DAYS AFTER MIXING. CALCULATED FOR COMPARISON ON THE BASIS OF THE SUPERPHOSPHATE IN EACH MIXTURE.

Mixture.	Super-phosphate.	Superphosphate plus—				
		4% Ground Lime-stone.	8% Ground Lime-stone.	12% Ground Lime-stone.	20% Ground Lime-stone.	20% Slaked Lime.
Treatment	B	C	D	E	F	G
Phosphoric Acid (P_2O_5), per 100 parts of Superphoshate in Mixture.						
Water Soluble ...	18·80	18·05	17·83	17·08	15·36	2·58
Citrate Soluble ...	1·45	2·09	2·55	3·43	4·92	17·25
Acid Souble	·95	·96	·92	1·04	1·04	2·07
Total ...	21·20	21·10	21·30	21·55	21·32	21·90

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Teakle, L. J. H., and Hill, H. E., 1943. The Rotting of Superphosphate Bags. *Jour. Agric., W. Aust.*, 20 (2). (*Second Series*), page 138.

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A Note on the Longevity of "Hard" Sub-clover Seed.

A. B. Adams.

This experiment, although conducted only on a laboratory scale, indicates that the protective coating of "hard" subterranean clover seeds prevents deterioration of their germinating properties over long periods, even after previous contact with superphosphate.

In 1929, a number of Dwalganup Early subterranean clover seeds were placed in superphosphate for some time and were then tested for germination. They were compared with seeds that had not been in contact with superphosphate.

Those that failed to germinate (from both lots) were assumed to be "hard" seeds, placed on one side for a further test, and forgotten until April, 1942.

On testing them again, 8.7 per cent. of the seeds that had been in superphosphate germinated, and also 11 per cent. of seeds that had not been in contact with the fertiliser, but the balance were quite unchanged.

The seed coats of ten unaltered seeds from each lot were scratched sufficiently to expose a little of the cotyledon and they were again tested for germination. All the seeds so treated germinated.

Hence it can be stated that the "hard" seeds of subterranean clover, in spite of rough treatment in 1929, survived with unimpaired germinating capacity until 1942.

Australian Dairy Produce Board (Pasture Improvement Committee) Species Trials.

H. G. ELLIOTT, Agrostologist.

F. E. RYAN, Field Technician.*

The Australian Dairy Produce Board Pasture Improvement Committee (W.A.) made available sums of money to be used for demonstrating to the farmers in this State means of improving the existing pastures.

The State Committee in co-operation with the Department of Agriculture decided to lay down two Species Trials to demonstrate the value of introduced species of grasses under dry land farming conditions.

Two properties were selected for these trials, one at Forest Grove and the other at Denmark. The trials have been in progress since 1937, and this article gives the information obtained.

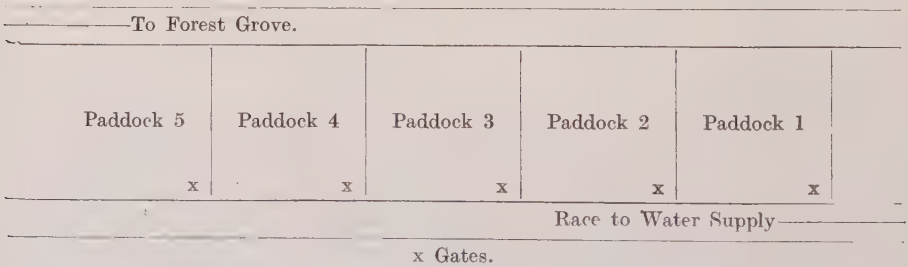
A. Millar, Forest Grove.

Introduction.—The pastures in the Forest Grove area consist mainly of pure stands of clover with volunteer annual grasses. They are generally subterranean clover but also drooping flowered clover (*Trifolium cernuum*) and certain minor clovers such as hop clover (*Trifolium procumbens*) and suckling clover (*Trifolium dubium*). The annual grasses are barley grass (*Hordeum marinum*) and brome grasses (*Bromus spp.*). In order to demonstrate the value of introduced grasses in improving the existing pastures, this trial was laid down in 1937.

Object.—The object of the trial was to demonstrate the value of the introduced grasses in improving the existing pastures and to show the need for the choice of suitable strains for these areas.

Materials and Methods.

Layout.—An area of 10 acres was selected on the property of Mr. A. Millar of Forest Grove and divided into five paddocks of two acres each as shown in the following plan.



The soil is red karri loam and was previously timbered with karri and red gum. It was cleared about 12 years before the commencement of the trial and grew subterranean clover for a number of years. It was cropped with maize and this was followed in 1936 with oats and peas. Ploughing was delayed in 1937 to give the weeds time to germinate and the area was plowed with a disc

* Field technician employed by the A.D.P. Board Pasture Improvement Committee (W.A.).

plow, cultivated with a spring-tyne cultivator, harrowed, rolled (using T bar roller) seeded and then cross rolled. The sowing took place in May and the area was sown as follows:—

Paddock 1.	Commercial perennial ryegrass	8 lb. per acre.
Paddock 2.	Yorkshire fog	4 lb. per acre.
Paddock 3.	Italian ryegrass	8 lb. per acre.
Paddock 4.	Phalaris tuberosa	4 lb. per acre.
Paddock 5.	Clunes perennial ryegrass	8 lb. per acre.

Germination.—A good germination occurred on all paddocks and heavy rain was experienced during the first two months, twenty-four inches being recorded between April, 14th and June, 29th. A spell of fine weather at the end of June ensured a successful establishment of the sown species.

Reports on Growth.—Observations were made in August, 1937; the commercial perennial ryegrass, Clunes perennial ryegrass and Phalaris tuberosa were making very strong growth. Italian ryegrass was making moderately good growth and Yorkshire fog was somewhat slow in making winter growth. It was noticed, however, that no clover had grown on the areas since the very thorough working and in the autumn of 1938, midseason subterranean clover was sown at the rate of 2 lb. per acre.

In April, 1938, it was evident that the ryegrass and Phalaris tuberosa had successfully withstood the summer drought period and were making very good recovery.

Paddock 5 (Clunes Victorian perennial ryegrass) was very good and only slightly better than the commercial perennial ryegrass on Paddock 1. Phalaris tuberosa was growing very strongly but the plants were more scattered than the ryegrass.

The Yorkshire fog paddock was weakest of all. Light grazing was carried out in January, 1937, and in April, 1938, and observations made in June, 1938, revealed that Paddocks 4 and 5 were recovering well and that Paddocks 1, 2, and 3 were more backward. Paddock 3 with Italian ryegrass appeared to be going back to clover whilst Paddocks 1 and 2 were inferior to Paddocks 4 and 5.

In October, 1938, subterranean clover was growing strongly to become the dominant species in the pasture. The Clunes perennial ryegrass was still growing vigorously on Paddock 5.

1939.—Paddock 4 was improving, having a greater number of plants than during the previous year. Clunes perennial ryegrass and commercial ryegrass were the grasses during the summer months.

Plot 1—Commercial perennial ryegrass.

During 1938 the ryegrass on this paddock made good recovery following the summer drought of 1937-38 and grew strongly. However, it was slightly inferior to the Clunes perennial ryegrass on Paddock 5. By June it was observed that this paddock was somewhat backward and was not making such good winter growth as were Clunes perennial ryegrass or Phalaris tuberosa. By October, the midseason clover which was sown in the autumn of 1938 had become the dominant species in the pasture. Over the summer months this paddock grew strongly and was almost as good for these months as Paddock 5. During 1939 it became evident that the commercial ryegrass was going out and failing to persist and in the autumn of 1940 this paddock was replowed and sown with Clunes perennial ryegrass.

Subsequent growth on this paddock has been disappointing, this being due to lack of grazing management. The lack of efficient grazing management was brought about by the death of the farmer. Subsequently the paddocks were thrown open and a form of continuous grazing adopted in place of the intermittent or rotational grazing previously in use.

Plot 2—Yorkshire Fog.

Following a very good germination, this grass failed to make very much growth during the winter months and in this respect proved inferior to the Clunes ryegrass and to Phalaris tuberosa.

During 1938, following the summer drought of 1937-38, this paddock proved to be weakest of all; the winter growth was slow and inferior to that on Paddocks 4 and 5. By October the midseason sub. clover which had been sown in the autumn of 1938 had become the dominant species in the pasture. During 1939 this paddock was very poor and it was replowed in 1939 and resown to Clunes perennial ryegrass.

This paddock has since proved disappointing for the reason given for Paddock 1, that is, it has failed to persist.

Plot 3—Italian Ryegrass.

Italian ryegrass made moderately good growth during 1937, and an excellent recovery was recorded in 1938. The winter growth was somewhat disappointing and was inferior to Paddocks 4 and 5. The subterranean clover was very good on this paddock by October. A full stand of Italian ryegrass was obtained in 1939 and good growth was obtained throughout the year.

During 1940 growth was again good but the stand was not so thick as previously, and it was evident that the Italian ryegrass was going out. During 1941 only a few plants could be found, and by 1942 this grass had completely disappeared.

Plot 4—Phalaris tuberosa.

After a good germination in 1937, strong growth of Phalaris occurred during the year. Good recovery following the 1937-38 summer drought was obtained, and during 1938 the plants grew very strongly but were somewhat scattered. The winter growth on this paddock was good and compared favourably with Clunes perennial ryegrass—these two paddocks being superior to the other three.

During 1939 the plants of Phalaris thickened up considerably and a good pasture was obtained. During 1940 the Phalaris on this area had thickened to form a reasonably good pasture and during 1941 and 1942, both this paddock and No. 5 were superior to the remaining three paddocks.

Plot 5—Clunes Perennial Ryegrass.

A good germination of this grass occurred in 1937, and growth continued well during the year. Recovery following the summer drought of 1937-38 was very good, and this paddock was the best of the five paddocks although only slightly better than Paddock 1 in the second year. The winter growth during that year was also very good. During the spring months this paddock developed into a good pasture mixture as the result of a good growth of subterranean clover following the seeding in autumn 1938.

By 1939 this paddock had become well established and was without doubt the best paddock of the series.

Over 1940, 1941, and 1942, this paddock continued to provide a good pasture of perennial ryegrass by the subterranean clover present in the sward deteriorated except on a strip which was fertilised with bluestone.

GENERAL.

Subterranean Clover.—When the trial was first laid out, it was expected that a regeneration of subterranean clover would provide the legume for the grass-clover association. This did not prove to be the case and during the first year (1937) very little subterranean clover was present on the paddocks. As a result of this midseason sub. clover was sown in the autumn of 1938 and a comparatively good stand had been obtained by October of that year over all paddocks.

During 1939 the stand of sub. clover declined and was replaced to some extent by minor clovers—hop clover, suckling clover, etc. A strip of bluestone and another of manganese sulphate was applied in the autumn of 1940 across all paddocks to encourage the growth of sub. clover. The bluestone strip produced a reasonable stand of sub. clover in 1941 and had become well established on this strip in 1942. Thus it can be reasonably assumed that the failure of the clover to form a pasture with the introduced species was due to a deficiency of copper in the soil.

Clunes Perennial Ryegrass.

When paddocks 1 and 2 failed to persist, they were ploughed up and resown with Clunes perennial ryegrass. This grass had originally been sown on paddock 5 and proved very successful, but on paddocks 1 and 2 a much poorer stand was obtained. This apparently was due to:—

(1) The comparative lack of fertility due to the failure of the sub. clover to persist on these paddocks; and

(2) Inefficient management of the paddocks during 1940, 1941 and 1942.

In respect to (1), it was noted that a better result was obtained on the bluestone strip than on the remainder of the paddocks because of the increased growth of clover on this section.

In respect to (2) it is necessary to point out that when the paddocks were first laid down, they were given very good management and attention, but following the death of the farmer the system of management was altered and this may have been responsible for the poor establishment.

DENMARK RESEARCH STATION.

In order to test the value of various perennial species and strains of perennial grasses at Denmark a species trial was commenced in 1937.

The trial consisted of five paddocks, each of two acres, which were planted with the following:—

Paddock 1—Phalaris tuberosa	4 lbs. per acre.
Paddock 2—Clunes perennial ryegrass (Vic. certified)	8 lbs. per acre.
Paddock 3—Yorkshire fog	4 lbs. per acre.
Paddock 4—Italian ryegrass, New Zealand	8 lbs. per acre.
Paddock 5—Commercial perennial ryegrass	8 lbs. per acre.

The trial was laid down on Fields 15 and 18 of the Denmark Research Station.

The soil types represented on these paddocks are as follows:—Paddocks 1, 2 and 3 consist mainly of grey sandy loam which extends to the subsoil.

The coarser sand and gravel country comes into the south-western corner of this six acres and covers approximately one acre.

The south-west corner of paddock 5 is stony with small outcrops coming through the surface. The remainder of this paddock is sandy loam of good depth. Paddock 4 has a sandy loam surface but is underlain with gravel at about two inches.

OBJECTS.

1. To determine what species are most suitable for incorporating into the existing sub. clover pastures in the Denmark region.
2. To demonstrate the value of certified strains of seed over commercial seed.
3. To record the periodicity of growth of the various species and their persistence in this district.

MATERIALS AND METHODS.

Cultivation.—The area was ploughed on 2nd May, 1937. It was then harrowed six times and rolled twice. The paddocks were sown on 17/3/37 and the area harrowed following seeding.

Fertiliser.—At the time of sowing, superphosphate and ammonia No. 3 were applied at the rate of 2 cwts. per acre and a spring application of 1 bag of superphosphate per acre was made in September, 1937.

1938	2 cwts. super. per acre applied in Autumn 1 cwt. super. per acre applied in Spring	Total, 3 cwts. per acre.
1939	2 cwts. super. per acre applied in Autumn 1 cwt. super. per acre applied in Spring	Total, 3 cwts. per acre.
1940	2 cwts. super. per acre applied in Autumn 1 cwt. super. per acre applied in Spring	Total, 3 cwts. per acre.
1941	2 cwts. super. per acre applied in Autumn 1 cwt. super. per acre applied in Spring	Total, 3 cwts. per acre.

Plot 1—Phalaris tuberosa.

An excellent germination of Phalaris tuberosa occurred and the plants made vigorous growth during 1937. The recovery of sub. clover following the cultivation was very poor and only a small quantity of this clover was growing in conjunction with the Phalaris during the first year. A fair amount of bracken had grown on the plot and this was mown in September and again in November to control the ferns.

The recovery following the very dry summer period of 1937-38 was very good and in this respect Phalaris proved more drought resistant than the other species sown.

By March, 1939, the Phalaris paddock was becoming fairly well established, was very vigorous and the plants were spreading. By August the establishment of the Phalaris was complete. Sub. clover had thickened up and formed a dense cover, particularly on the western end.

In January, 1940, paddock 1 was cut for hay and the estimated yield from this paddock was 2-2¼ tons. By June, 1940, Phalaris tuberosa was making prolific growth and was grazed down. Growth and production from this have continued and the pasture is still vigorous and productive.

Plot 2—Clunes Perennial Ryegrass.

As with Phalaris an excellent germination of Clunes perennial ryegrass was obtained, but as for Paddock 1 there was practically no clover during 1937. The bracken fern on this paddock was mown in September and again in December to control the fern.

Following the drought of 1937-38 summer period, the Clunes ryegrass recovered fairly satisfactorily, but not so well as Phalaris tuberosa.

By March, 1939, this paddock was becoming fairly well established, but was somewhat patchy. By July the ryegrass was growing very well in conjunction with sub clover which had thickened up to a very dense stand.

In January hay was cut from the paddocks and its estimated weight was 36-38 cwts.

Observations made just before spring revealed that this paddock had become firmly established as an excellent pasture sward.

During 1941 the paddock maintained a good balance of grass and clover and formed an excellent pasture sward. This paddock has given very good results and the suitability of Clunes perennial ryegrass has been clearly demonstrated.

Plot 3—Yorkshire Fog.

A very high percentage germination was obtained and all plants showed vigorous growth to such an extent that practically full ground cover was obtained in the first year. However, there was a complete absence of subterranean clover.

Recovery following 1937-38 summer drought period was not so good as paddock 1, but was reasonably good.

By March, 1939, the Yorkshire fog was well established and flourishing. A strong stand of subterranean clover had developed and a good pasture had resulted.

In January, 1940, an estimated weight of 38-40 cwts. of meadow hay was cut from this paddock.

In the beginning of spring, 1940, this paddock had produced an excellent pasture, which it maintained during 1941, but at the last inspection in 1940, it was beginning to thin out, indicating that this grass was not as persistent in this area under intensive controlled grazing as Phalaris tuberosa or Clunes perennial ryegrass, but has proved a very valuable grass for this district.

Plot 4—Italian Ryegrass.

This paddock showed reasonable germination in the first year, but had a very heavy growth of annual weeds. During the establishment year this paddock was mown to control these annual weeds.

During 1938 very good growth occurred on this paddock and it provided more grazing than either of the other four paddocks.

During 1939 the stand of Italian ryegrass began to thin out and by 1940 this grass had disappeared.

Plot 5—Commercial Perennial Ryegrass.

A reasonable germination was obtained from this paddock in 1937, but it was heavily infested with annual weeds, mainly grasses. This paddock was also mown to control this annual growth.

During 1938 this paddock produced a reasonable amount of pasture and was equal in grazing to paddock 2.

By March, 1939, this grass had practically gone out and in that year the paddock was reploughed.

GENERAL.

Some interesting observations were made over the 6-year period during which the trial was in progress. During 1939 Italian ryegrass which might be expected to get away early was very slow in making growth and in the first report in March, 1939, very little of it could be found, although the perennial grasses were making reasonably good growth. This ability of perennial grasses to produce a good early bite enhances their value as pasture plants, providing that they are not overgrazed at this period.

In 1938, during the first months of the year, a severe drought occurred and it was noted that Phalaris tuberosa was superior to the other species in its recovery.

During the January of 1940 a heavy fall of rain occurred and there was a decided increase in production from the few plants of Paspalum dilatatum which were present in the sward. This is a summer growing grass and the unusual nature of the early rains enabled it to make fairly good growth as opposed to the slower response from the winter growing species in the paddocks.

The invasion of paddocks 4 and 5 with what appears to be a local perennial ryegrass is of interest, and it is probable that by selection good local strains of perennial ryegrass may be obtained from this area.

Botanical Analyses.

Botanical analyses were made in July and August of 1939, in September-October of 1941, and again in September of 1942. They may be summarised as in the attached table.

BOTANICAL COMPOSITION OF PADDOCKS.

Species.	17-7-39.			11-8-39.			September, 1941.			September, 1942.		
	Paddock 1.	Paddock 2.	Paddock 3.	Paddock 1.	Paddock 2.	Paddock 3.	Paddock 1.	Paddock 2.	Paddock 3.	Paddock 1.	Paddock 2.	Paddock 3.
Clunes perennial ryegrass	....	15·7	....	....	10·85	....	....	43·0	....	....	50	....
Phalaris tuberosa	6·95	....	....	8·45	....	....	16·0	....	....	28·7	....	....
Yorkshire fog	....	....	26·9	....	....	19·7	....	....	29·0	....	....	20·7
Subterranean clover	81·0	73·5	69·3	83·2	81·80	72·3	58·0	38·0	62·0	65·5	49	75·3
Weeds	4·1	0·9	1·2	2·50	1·15	1·05	8·0	14·0	9·0	....	....	....
Other grasses	3·8	3·0	0·5	4·05	0·3	3·55	16·0	....	....	5·8	1·0	4·0
Bare ground	4·15	6·9	2·1	1·80	5·9	3·40	3·0	5·0	....	....	....	....

The botanical analyses show the increases in the various sown grass species occurring between 1939 and 1942. Thus the percentage composition of Clunes perennial ryegrass increased from 10.85 per cent. in 1939 to 50 per cent. in 1942. Phalaris increased from 8.45 per cent. in 1939 to 28.7 per cent. in 1942, whilst Yorkshire fog increased from 19.7 per cent. in 1939 to 29.0 per cent. in 1941, and then declined to 20.7 per cent. in 1942.

Grazing.

During 1937 all paddocks received about the same amount of light grazing.

During 1938 the Italian ryegrass plot provided most grazing, whilst the Yorkshire fog paddock was slightly better than the remaining three paddocks.

During 1939 Phalaris tuberosa paddock was slightly below the Clunes perennial ryegrass and Yorkshire fog.

During 1940, however, the more drought resistant Phalaris was superior to both Clunes perennial ryegrass and Yorkshire fog.

During 1941 all paddocks provided the same amount of grazing, but it was noted in 1942 that the Yorkshire fog paddock was beginning to thin out and it appeared to be failing to persist.

SUMMARY.

A species trial with Phalaris tuberosa, Clunes perennial ryegrass, Yorkshire fog, Italian ryegrass, and commercial perennial ryegrass was conducted on the Denmark Research Station, Denmark.

Good pastures of Phalaris tuberosa and subterranean clover, Clunes perennial ryegrass and subterannean clover, and Yorkshire fog and subterannean clover were obtained within three years of establishment. Italian ryegrass produced an excellent temporary pasture which failed to persist after three years and commercial perennial ryegrass produced a reasonably good stand during the first two years and then failed to persist.

After a 6-year period Phalaris tuberosa and Clunes perennial ryegrass were well established and growing vigorously and Yorkshire fog was beginning to die out.

Over the whole period there was very little difference between the carrying capacity of the three pastures, but during the drought period Phalaris was more productive than the other two species.

During 1941 all paddocks provided the same amount of grazing during the good season following the 1940 drought year.

This demonstration has shown the suitability of Phalaris tuberosa and Clunes perennial ryegrass and also the suitability of Yorkshire fog for this district over a 6-year period. It has also demonstrated the temporary nature of Italian ryegrass and the inferiority of commercial perennial ryegrass to Clunes certified perennial ryegrass as pasture species in this district.

This trial has served a valuable purpose in demonstration of the value of the various species to the farmers and much interest has centred upon it during the various field days when the attention of farmers was drawn to the results obtained from year to year.

ACKNOWLEDGMENT.

Grateful acknowledgment is made of the assistance given by Mr. V. Randell, Manager, Denmark Research Station, in respect of grazing, fertiliser, and general management, and for keeping the necessary records. Also acknowledgment is made of the assistance given by Mr. and Mrs. A. Millar, Forest Grove, for providing the land and assisting in the conduction of the trial.

Whey as a Food for Calves and Pigs.

V. WESTON, Dairy Instructor.

Whey is the by-product of a cheese factory, and its utilisation to the best advantage is an important part of the economy of dairy farming and cheese manufacture. As facilities in this State for drying and preparation of lactose are not available, this by-product must essentially be used as animal food. For this purpose it is particularly valuable for rearing calves and pigs.

With increasing cheese manufacture, large quantities of whey are available in Western Australia from June to January, and during past seasons much of this has gone to waste through a lack of appreciation of its possibilities. New Zealand underwent the same phase years ago when most of the whey went down the drains, but today due to experience and better information, many factories have installed scales to ration back whey to their suppliers.

There are different types of whey, but here we are concerned with one only, that which contains those substances in the milk serum not held up in the rennet coagulum, together with a small portion of curd broken up during the manufacturing process.

Whey is best fed in as fresh a condition as possible, when only a small percentage of lactic acid has been produced. Excessive acidity not only reduces the sugar content but will cause digestive disorders. A small handful of lime to every 40 gallons will correct the acidity and at the same time provide a very necessary mineral. Most factory managers arrange for the neutralising and the sterilisation of the whey, the latter arrests further fermentation or putrefaction and also safeguards the spread of disease germs. Separate holding vats are usually provided for pigs and calves.

The following table shows the solids analysis of whey, skim-milk, and whole-milk:—

	Whey.	Skim-milk.	Whole-milk.
Proteins	·8	3·1	3·45
Sugars	4·7	4·9	4·8
Fats	·3	·1	3·8
Ash	·7	·7	·75
Total Solids	6·5	8·8	12·8

From this it will be seen that whey contains 6·5 per cent. of solids as against 8·8 per cent. for skim-milk, and 12·8 per cent. for whole-milk, thus whey has about three quarters the feeding value of skim-milk and one half the value of whole-milk. It must not be assumed, however, that by feeding twice as much whey the same result as with whole-milk can be obtained. Animals overfed on whey give disappointing results with possible scours and bloating.

Whole-milk may be taken as a naturally balanced food, that is the solid constituents of protein, sugars, and fats are in the proportion most suitable for promoting the maximum growth or flesh gain. The nutritive ratio is 1 : 3·9, whereas with whey the ratio is much wider at 1 : 6·8. Therefore the stock feeder must narrow this ratio by adding suitable concentrates to the ration supplying those substances which are deficient.

In the article "Pigs, Breeding and Management," by G. K. Baron Hay, Leaflet No. 496, the subject of pig feeding is thoroughly dealt with, and nutritive ratios and balanced rations of various foods can be further studied; but here, the economical utilisation of whey is reviewed rather than the best methods of pig raising.

With whey the fats and proteins have been almost removed, and to bring one gallon of whey to the feeding value of one gallon of milk, it is necessary to add ⅓ lb. of fat and ¼ lb. of protein. This, however, is subject to modification in that good pasturage, hay, and concentrates should be available apart from swill feeding, and from these sources some of the deficiencies will be obtained.

The following are common concentrates with a high percentage of fats and proteins, which have been found suitable for balancing the whey ration:—

	Protein.	Sugars.	Fats.	N. Ratio.
Meat meal	48·4	nil.	10·2	1 : 0·5
Linseed meal ..	20·6	17·0	29·0	
Pollard	13·4	46·2	4·4	1 : 4·2
Wheat bran ..	12·5	41·5	3·0	1 : 3·9

A rich protein food such as meat meal is most desirable in the ration together with wheat, barley, oats, bran or pollard, to utilise the maximum amount of whey, or in other words, to raise the maximum number of pigs or calves from a given quantity of whey. This is important for those distant from the factory, as cartage is an expensive item.

It is difficult to arrive at the monetary value of whey, but we know that it is not so valuable as skim milk, as more concentrates are necessary for the same result. An interesting experiment was carried out in Canada which amply demonstrates its value. Two pens of twelve pigs were selected and fed for 120 days, one pen on whey and meal, and one on water and meal, the weights of the pigs and the quantities of food consumed were noted with the result below:—

Pen 1.—169 lb. meal and 747 lb. whey to produce 100 lb. weight increase and day gain of 1·16lb.

Pen 2.—430 lb. meal and water to produce 100 lb. weight increase and day gain of 0·7 lb.

Taking meal at 1d. per lb. there is a gross saving of £1 1s. 9d. per 100 lb. weight increase, and a much faster rate of maturity as well.

Other than meal, cartage costs will be the main item at present, as the whey is obtainable free. With those farmers carting milk to the factories and able to "back load" this is reduced to a bare minimum as also those in close proximity to the factory.

It must be noted that under the Dairy Industry Act and its regulations, cans used for the delivery of milk or cream must not be used for the carriage and storage of whey.

However, suffice to say that in recent extensive pig feeding trials on farms in New Zealand, using meat meal and whey, the average net value of the whey was ¾d. per gallon, or every gallon used on the farm realised a profit of ¾d. By rearing calves, a better return again is obtained.

FEEDING PIGS.

The following table is a simple guide to the quantities of meal and whey successfully used in New Zealand:—

	Whey gals.	Meal lb.
Sows before farrowing	6—10	2—3
After farrowing	10—20	3—4
Litters (per pig)	1 pt.—2½	2oz.—8oz.
Weaners and stores	2½—5	½—1
Porkers and baconers	5—8	1

In the above, meal contains at least half meat meal with the balance crushed grain, bran or pollard. The feeder must exercise his judgment, some pigs will utilise whey better than others.

Points to remember.

Feeding is often advocated five times daily, if possible, to enable the pigs to consume the large quantities of whey and so not overtax their digestive system.

Feed in as fresh a condition as possible, neutralise high acid with lime, and keep drums and troughs reasonably clean and throw out unused whey, don't keep till next day.

Make sure whey is sterilised at the factory to prevent introducing disease.

Make sure whey is not diluted with factory "washings," as diluted whey gives unsatisfactory results.

Stale acid whey can cause pigs to scour.

Pigs should have access to good pasture—grass provides useful roughage as well as minerals. It helps to limit the intake of whey and provides exercise.

Mix meal with whey just prior to feeding each meal rather than once for the whole day, this will restrict fermentation in the storage drums and allow all the pigs to get some meal.

Sudden changes in the rations should be avoided since whey contains a small quantity of highly concentrated dry matter and a large amount of water. Pigs on whey develop ravenous appetites and the intestines become accustomed to handling the small quantity of dry matter. If the ration is changed suddenly to solid foods, severe digestive disorders often set in with possible ruptures.

FEEDING CALVES.

Whey is a good substitute food for rearing calves and offers an excellent opportunity for those farms on whole-milk to rear calves and augment the income and ease the problem of herd replacements. It is a fallacy to think that skim-milk is essential for this purpose.

At Brunswick a number of farmers have successfully reared whey calves for some years, and the pioneering stage is definitely over. Messrs. Browne's, Ltd., Cheese Factory rear 30-40 calves yearly by the following method. Feed whole-milk for 14 days and then five per cent. whey and milk for 14 days, gradually increasing until calves will take all whey. Linseed meal was the concentrate used at the

rate of about ½ lb. per calf per day with from 1-2½ gallons of whey. The writer has seen these calves at all stages during the last two years and they have always looked well, notwithstanding the fact that insufficient pasturage was available.

Mr. J. Kasten is another successful rearer and his methods are outlined below.

Rears calf on whole-milk for one month and then straight on to whey, feeding about ¾ lb. of pollard to 1-1½ gallons of whey per day in two feeds. He does not believe in changing gradually to whey as the whey tends to curdle the milk (this could be corrected by the use of more lime). He finds calf takes to it as soon as properly hungry and without any ill effects. As the calf grows older whey may be increased up to 2-3 gallons. At all times Mr. Kasten has pasture, chaff, and bran available. He maintains the calves thrive better than on skim-milk and consume it with greater relish.

The methods recommended by A. C. T. Hewitt, M.Agr.Sc., Live Stock Science Officer of the Victorian Department of Agriculture, are condensed as follows:—

Calves to be fed whole-milk for two weeks. Next three weeks gradually replace by whey. For the best results mix ¼ lb. of linseed meal or a mixture of linseed meal and pollard with each gallon of whey fed; but whey only can be used, and by the sixth week the calves will do well on whey as the only bucket feed.

Feeding Table.

	Milk. lb.	Whey. lb.
First week up to	12	—
Second week	12	—
Third week	9	5–10
Fourth week	6	10–15
Fifth week	3	15–20
Sixth-twenty-fourth week	—	20–30

To be fed daily in two feeds and warmed to a temperature of 90°F.

It is essential that the whey be as fresh as possible, sterilised and undiluted.

Feed calves separately for best results and don't overfeed. Calves should be grazed on good pasture supplemented with good hay, chaff and concentrates.

REFERENCES.

"Facts About Whey," H. M. Pierson, Extension Officer in Pig Husbandry, New Zealand.

"Whey as a Stock Food," A. C. T. Hewitt, Livestock Science Officer, Victoria.

"Pigs and Their Management," H. W. Potts.

Management of an Apiary.

L. BLAIR, Government Apiculturist.

The management of the apiary is of vital importance to the apiarist, and determines in a great measure his returns in honey. To sum up, it is always necessary to have the hives strong just prior to a flow of nectar. Nectar, I might explain, is the exudation of flowers to entice insects to visit them, and in the process of visiting, these insects sup the sweet liquid, called nectar, and in exchange, the flowers become pollinated, as grains of pollen are caught in the hairs of the visitors' bodies and legs and thus transferred from the male to the female flowers. Thus nature works, and the flowers fertilised in this manner, set seed or fruit, sometimes both.

As can be readily understood, if the hive is not strong at the beginning of the flow, there is a large loss of honey. For illustrative purposes, we will suppose a hive is weak at the beginning of a flow. Honey and pollen is coming in; the Queen starts laying and everything is going along merrily inside the hive, with the young bees expanding in the brood nest, and plenty of both honey and pollen on which to feed them. Now comes the time factor, and this is in strict accordance with the average flow or blooming period of most flowers, say six to eight weeks. Some flowers of course, bloom over a longer, and some over a shorter period. Now compare this with the time factor in the hive. The Queen is governed in her egg-laying capacity by the food coming into the hive, and these eggs, from the time they are laid until they are hatched, take three weeks. When the young bees are hatched, there is a further period which they spend in the hive as they pass from one duty to another, such as acting as nurse bees to attend to the feeding of the younger bee life, and by the time they are old enough to take their turn at field work, there is a period of about 4½ to five weeks gone from the period of the honey flow. Consequently, the hive which was strong at the beginning of the honey flow should have gathered at least 30 to 60 lb. of honey, and will show at least double the return of the hive that started off from scratch, or when the flow first started.

There are also a number of other factors which govern the returns, i.e., the Queen, the frames, and the size of the hive. We will start with the Queen. It is always advisable to have a young, or good Queen, or, shall I say, a Queen who gives results, as some Queens, though old, are still good, and some young ones useless. It is advisable to cull out poor and indifferent Queens and replace them with prolific ones to obtain the best results. Culling Queens is a very good business, as it eliminates their bad characteristics. It comes very hard to kill a beautiful Queen, but after a reasonable trial it is the only sensible thing to do, as her bad properties may be transmitted through her male progeny, the drones, and in course of time, ruin the hive. To improve the hive and obtain the best results, this culling must be a continual process.

The frames also are a very vital factor if the best results are to be obtained, and these are bound up in the hive having the greatest amount of worker bees at the correct time. This cannot be attained if half the comb the Queen has at her disposal in which to lay is old, thick, unusable, and contains a large percentage of drone comb which should have been melted down years previously.

We will compare it this way: Take two hives. No. 1 has, we will say for comparison, 50,000 worker bees, and No. 2, owing to bad combs and reduced space for the Queen's lay, has 20,000 workers. It is obvious which will bring in the larger amount of honey. This same comparison also applies to the size of the hive. I

am not referring to standard sizes, such as the eight or 10 frame, factory-made article, or the usual nine-frame, home-made hive, but to the supers, and I will compare it this way:—

No. 1 *hive.*—Is just a full-depth body, and we will call it the brood chamber.

No. 2 *hive.*—Is one full-depth body or brood chamber, and one full-depth super.

No. 3 *hive.*—Is a hive with a full-depth body or brood chamber and two full-depth supers. We will assume that the three hives in question are headed by three good Queens, one in each, and the combs and hives are good average ones. Now we will examine results.

No. 1. *The single hive.*—The bees get busy when the flow starts, and quickly fill up the single apartment which is at their disposal, and they cannot expand or store any more honey, brood, or pollen. Result, they will either swarm to escape the small house, and seek increased accommodation, or if towards the autumn, they will just loaf, and sit about the entrance and wait for the winter. Then perhaps the owner may decide to do a little extracting, and on opening the hive gets one or two frames of honey on the sides, which may amount to 10 or 12 lb. in weight, and the rest of the frames are all filled with brood and pollen (Gain —12 lb. honey).

No. 2. *The double hive.*—This hive gets busy like No. 1, and fills the bottom body and this time, just prior to the bottom body being filled, the apiarist adds a super, taking out a frame from the nearly filled body and placing it in the super, and replacing an empty brood comb in its place from the super. This comb from the bottom body acts as a bait, and induces the bees to expand into the super, and the work progresses. In a short time, the super is also filled, and as with No. 1, the apiarist then does some extracting. This time, he will probably be able to extract seven or eight nicely capped honey frames, which will weigh in the vicinity of 35 lb. (Gain—35 lb. honey).

No. 3. *The treble hive* (with extra full-depth super).—This hive starts off with the others, and a similar process is followed as with No. 2, save that a second super is added just prior to the first super being filled. This hive will take a little longer to fill the two supers, but they, with extra storing space for ripening the nectar, and more room for the Queen to lay in, have the advantage in many ways, particularly if the apiarist is late in extracting, as the other two hives are full and loafing, and the three-decker is still working and storing honey.

However, the apiarist extracts in due course, and from the three-decker, he will take 12 to 15 frames of honey, say 75 lb. (Gain—75 lb. honey).

By this comparison, I do not wish to infer that the addition of supers can go on indefinitely, but it is preferable to add supers in the event of the bee-keeper being too busy to extract, rather than have the bees loafing.

In the United States supering is carried to seven and even nine frames, but this requires a great deal of extra equipment, and introduces the risk of toppling over. I think the three-decker an admirable all-round utility size, as a good hardy strain of bees in normal years can protect this size throughout the year in Western Australia.

Further information may be obtained by writing to the Department of Agriculture on any subject dealing with management of the apiary, and bee-keeping in general.

Agricultural Broadcasts.

The following programme of Agricultural talks has been arranged for the July-September q[illegible] and will be broadcast from Stations 6WN and Regionals at 7.15 p.m. each Tuesda[illegible]

Date.	Talk Prepared by :	Title.	Summary.
	I.—FARMERS IN A CHANGING WORLD SERIES.		
July 27	Dr. E. J. Underwood, Animal Nutrition Officer in the Department of Agriculture, and Chairman State Nutrition Committee	Implications of the United Nations Food Conference, Part I.	The reasons for calling the Conference and its historical background will be outlined together with a discussion of the conference findings and their implications for the immediate post-war world.
Aug. 24	do. do. do.	Implications of the United Nations Food Conference, Part II.	The implications of the Conference for Australian Agriculture and Australian standards of nutrition will be discussed.
Sept. 21	Mr. G. H. Burvill, Assistant Plant Nutrition Officer in the Department of Agriculture	Changing Ideas on Soil Cultivation	Soil cultivation is an art with centuries of tradition. Clean and regular cultivation has been regarded as good practice in farming and gardening. But scientific experiments do not support many traditional ideas and the menace of soil erosion also calls for changes in cultivation methods.
	II.—TOPICAL ITEMS.		
July 6 Aug. 3 Aug. 31 Sept. 28	Mr. G. K. Baron Hay, Under Secretary for Agriculture will discuss current events of importance to the farmer		
	III.—FARMER'S FORUM.		
July 13 Aug. 10 Sept. 7	Discussion will be arranged by Dr. G. A. Currie, Professor of Agriculture in the University of Western Australia, on topics submitted by farmers		
	IV.—TECHNICAL TALKS.		
July 20	Mr. C. F. H. Jenkins, Government Entomologist, Department of Agriculture	The Sheep Blowfly Problem	A brief description of the flies concerned in the problem will be given, together with details of their life histories and habits. The latest recommendations for the treatment of fly strike will also be described.
Aug. 17	Mr. E. T. Morgan, Officer-in-Charge of the Potato Branch, Department of Agriculture	Seasonal Hints for the Home Vegetable Garden	
Sept. 14	Mr. H. G. Cariss, Agricultural Adviser, Wheat Branch, Department of Agriculture	Fodder Conservation in the Wheat Belt	Methods of conserving fodder and how to feed it to animals.